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The following papers are appearing in the May, 1957, issue of the *Journal of Applied Chemistry*

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Kinetics of catalytic oxidation of sulphur dioxide for comparison of fixed and fluid bed reactors
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STUDIES ON BANANA PSEUDOSTEM STARCH: PRODUCTION, YIELD, PHYSICO-CHEMICAL PROPERTIES AND USES

By V. SUBRAHMANYAN, G. LAL, D. S. BHATIA, N. L. JAIN, G. S. BAINS, K. V. SRINATH, B. ANANDASWAMY, B. H. KRISHNA and S. K. LAKSHMINARAYANA

The presence of considerable quantities of starch in the banana pseudostem has been demonstrated for the first time. Evidence is presented to show that the starch content of the stems varies and is influenced by the variety, locality, stage of growth, physiological state of the plant and climatic conditions, and particularly by the moisture content of the stems. The desirability of screening varieties with a view to selecting consistent yielders has been emphasized.

The process evolved for the manufacture of banana pseudostem starch is outlined, and the potentialities of this new raw material as a source of starch indicated.

Physico-chemical properties of the starch have been described. The starch can be used for industrial and edible purposes in place of ordinary starches. Sizing tests have shown that it compares very favourably with the common starches and, in view of the somewhat transparent nature of the pastes, imparts better lustre to the finished goods.

Introduction

Starch is found in nature as stored food in the tissues of higher plants and forms the bulk of the solids of grains and tubers. Raw materials commonly used for the manufacture of starch in different parts of the world are: food grains (maize, wheat, sorghum), tubers and roots (potato, sweet potato) and sago. In countries suffering from shortage of food, the availability of these materials for starch manufacture is limited. Investigations undertaken in this Institute on the processing of banana pseudostem (commonly called banana stem) for edible purposes revealed that the stems contained a substantial quantity of starch which could be released by mechanical means. The starch is present in the form of granules and can be demonstrated by pouring iodine solution over the cut stem.

Banana is extensively grown in tropical and subtropical countries of the world. In India, it is one of the most widely cultivated fruits, occupying an area of about 3 million acres.[1] After harvesting the fruit, the felled plant is generally allowed to rot in the field. The stem is used to some extent in the preparation of fibre ropes and cheap-quality paper, and the inner soft core is consumed as a cooked vegetable, but no important industrial use of the stem has so far been reported. Under Indian conditions there are about 800 plants per acre and each stem on an average weighs 50 lb. (Pseudostems weighing up to 150 lb. or even more are not uncommon.) It is estimated that about 5·5 million tons of this material are annually available in India and probably equally large quantities in many other countries.

The present investigations were undertaken to develop a suitable process for the recovery of starch from the banana stem. Various factors influencing the yield of starch, physico-chemical characteristics of the product and suitability for industrial purposes and for edible purposes have also been studied. It is shown that the starch can be used for any purpose for which other commercially available starches are used.

Experimental

Material and methods

Banana stems were obtained from gardens in and around Mysore. The variations of starch content in the stems in relation to variety and locality were studied in plants from Government experimental gardens at Aduthurai and Coimbatore, and in commercial orchards at Trichi (Madras State) and in Hiryur Taluk and Mysore (Mysore State). Standing plants were reserved in local gardens for specific experiments.

Starch content under field conditions was determined according to the rapid method of Jain *et al.*[2] and in the laboratory by the A.O.A.C. method after separation of the crude starch by repeated crushing of the material in a mortar and centrifuging the suspension. Intrinsic viscosity was determined by the procedure described by Kerr.[3]

Recovery of starch

Two procedures—wet and dry grinding—were adopted for extracting the starch. In the first, the material was ground fresh, usually in presence of excess of water, and in the second, the material was first dried and then ground and the powder mechanically agitated in water.

Wet grinding.—In preliminary experiments a Waring Blendor proved quite satisfactory for laboratory work. Material, cut into small pieces, was easily crushed in the presence of water. Practically all the starch was released in about three crushings, the liquid being separated off each time by passing it through a sieve of 60 to 70 mesh. The recovery of starch was 98–99%.

A high-speed emery wheel with a rough abrasive surface, and a rubber rasping machine studded with sharp steel spikes on a high-speed revolving wheel, also proved efficient. With both these devices the stem was gradually crushed into fine pulp which was thoroughly stirred with water, releasing practically all the starch.

A shredder consisting essentially of a rapidly revolving saw-toothed roller was also used. The whole stem was cut longitudinally into halves or quarters before being fed to the shredder. The product was a rather coarse pulp owing to the tearing action of the machine. Starch was then released by mechanical agitation of the crushed material in water.

Since the capacity of all these devices was limited, the possibility of adopting an ordinary power-driven cane crusher for preliminary crushing, followed by working up the crushed material in a paper pulp beater, was explored on a pilot-plant scale. The stems were cut longitudinally before feeding to the crusher. The fibrous material was crushed to small pieces and the pressed juice, which contained about 40% of the starch, and the fibrous material were transferred to the pulping tank and worked up with the paper pulp beater in the presence of water for about an hour. The liquid containing the starch in suspension was strained through a set of sieves of decreasing mesh size to eliminate the fibre, and the starch allowed to sediment in cylindrical vessels. The thick starch slurry was suitably diluted before tabling. The starch tends to settle quickly in the inclined tables while the light pulpy portions flow out with the effluent. Plain water was run into the tables for final washing of the product which was then scraped off, dried and powdered. Details of the process are covered by an Indian patent.[4]

With the different types of wet-grinding equipment, 60 experimental crushings, in which the size of the samples varied from 5 to 750 lb. of stems, were made. Consolidated yield data obtained are given in Table I and the data on actual recovery of starch by the different types of equipment are presented in Table II.

Table I

Samples falling in different yield range of starch

(Total 60 samples)

Starch content % (at 15% moisture)	No. of samples	Starch content % (at 15% moisture)	No. of samples
Below 1·0	8	3·0–3·9	6
1·0–1·9	23	4·0–4·9	5
2·0–2·9	16	5·0 and above	2

Table II

Recovery of starch by different types of mechanical equipment

Equipment	Action	No. of trials	Total material handled, lb.	Average recovery of starch, %
Emery wheel	Rasping, grating and pulping	16	506	97
Shredder	Tearing, cutting and grating; gives a coarsely crushed material	2	19	81
Cane crusher	Repeated crushing and tearing	4	1504	78
Paper pulp beater	Tearing, teasing and stirring	14	4566	82
Cane crusher and paper pulp beater	Combined effects of the above	13	4354	88

Dry grinding.—The freshly cut stems usually contain 86–95% water. The collection and transport of the material from remote and scattered orchards therefore presents practical problems. To facilitate collection and to economize on the cost of transport, the possibility of drying the stems before grinding and extraction of the starch was studied.

The stem was cut into small pieces and dried in the sun or partially dehydrated by pressing out the juice in a hydraulic press before drying. Some starch was released in the press juice which could be recovered in the usual way. The dried material was ground to about 50 mesh size.

The powder was soaked overnight in about 10 times its weight of water and strained through a 50-mesh sieve to separate the fibre from the starch suspension. The fibrous portion left on the sieve was stirred thoroughly with more water, followed each time by straining. The starch suspension was next passed through a 70-mesh sieve to remove finer fibre. The resultant suspension containing starch and very fine fractions of pulp was then tabled.

Factors affecting yield of starch

(i) *Effect of stage of growth.*—Preliminary observations on variations in starch content in relation to stage of growth are summarized in Tables III and IV. For a systematic study, however, four plants of *Rasbale* variety were tested for starch content periodically after the inflorescence stage. The results are given in Table V.

(ii) *Effect of variety, locality and season.*—Preliminary laboratory and pilot-plant trials revealed that the starch content of the stems varies considerably with the variety, locality and season. Some plantations were therefore surveyed to ascertain the range of starch content. The results are given in Table VI.

Table III

Qualitative examination of banana stem of Poovan *variety for starch**

Stage of growth	Colour with iodine solution
Pre-inflorescence	Light blue
Just after inflorescence (only few fingers out)	Colour intensity deeper than above
Bearing a bunch of tender fruits	Deep blue
Bearing a heavy bunch (still immature)	Almost instantaneous deep blue
Bunch almost ready for harvesting	,, ,, ,, ,,

* Plants examined on the same day in the same field at Mysore

Table IV

*Starch content of plants at different stages of growth** (*variety* Rasbale)

Stage of growth	No. of plants	Range, %	Mean starch content, %
Just before inflorescence	1	—	2·6
Post-inflorescence, tender fingers	4	3·0–4·06	3·5
Almost mature and ready for harvest	3	4·20–4·65	4·5

* Plants examined on the same day and in the same garden

Table V

Variation in starch content at different stages of growth after inflorescence (*variety* Rasbale)

Weeks after inflorescence	% starch (dry wt.) determined by rapid method — Plant No.				
	1	2	3	4	Average
0	33·4	35·7	31·5	36·8	34·35
2	39·2	42·4	35·5	42·4	39·88
4	40·2	48·0	37·6	47·1	43·23
Harvesting time	39·4*	49·5*	38·7†	52·0†	44·90
Starch % (mechanical extraction) at harvesting time	40·1*	51·7*	38·2†	49·1†	44·80

* Harvested 8 weeks after start of experiment
† Harvested 12 weeks after start of experiment

Table VI

Effect of variety, locality and season on the starch content of banana stems

Locality	Month	Variety	No. of gardens inspected	No. of plants examined	Yield of starch % Range	Yield of starch % Average	Remarks
Mysore	November	Rasbale*	3	3	3·8–5·2	4·5	Fully mature plant
	,,	Maduranga	2	2	3·7–5·0	4·4	,, ,, ,,
	,,	Poovan	1	1	—	1·9	,, ,, ,,
	July	Rasbale	1[a]	22	2·2–4·8	3·3	,, ,, ,,
	,,	Rajbale	1	1	4·1–5·6	4·7	,, ,, ,,
	August	Rasbale	1[a, b]	4	4·1–5·6	4·7	,, ,, ,,
	Sept. (end)	,,	1[b]	4	1·6–3·4	2·4	,, ,, ,,
Hiriyur Taluk (Commercial plantations)	November	Rasbale*	3	8	1·8–5·1	4·5	Within a week of maturity of the bunch
	,,	Salem Bale	5	17	1·0–3·4	2·2	
	,,	Pache Bale (Pache Nadan)	1	3	2·3–3·4	2·7	Rather immature and tender
	,,	Putt Bale	2	7	2·8–4·9	4·0	<4·0% in immature plants
	,,	*Kathbale*** (Maduranga)	3	3	3·0–4·0	3·5	3·0% in immature plant, others within a week of maturity
Aduthurai Experimental Farm	July	Poovan	1	12	(one plant each 1·0 and 0·5, others all <0·5)	0·5	All plants except 1 almost mature
	,,	Monthan**	1	9	Four plants 1·1, 1·5, 0·7 and 0·8; others 0·5 or less	0·5	Almost mature
	,,	Rasthali*	1	1	—	0·9	,, ,,
	,,	13 varieties	1	1 each	—	0·5 in all	Maduranga just after inflorescence, others about ¾ mature
	Sept.	Poovan	1	9	Max. 0·5	0·5	Fully mature
	,,	Monthan**	1	3	2·0–2·1	2·1	,, ,,
Trichi (Commercial plantations)	July	Rasthali*	1	5	0·5–1·2	0·8	Almost mature
	,,	Monthan**	1	4	—	0·5	,, ,,
	,,	Poovan	1	4	—	0·5	,, ,,
Coimbatore	,,	Miscellaneous	1	1 each	—	0·5	¼ to ½ mature

* Names for the same variety in different localities
** Names for a second variety in different localities
[a] Different gardens
[b] Same garden

(iii) *Post-harvest variations in starch content.*—Two experiments were undertaken. In the first, after harvesting the bunches, the plants were allowed to remain unfelled for 8 days. Samples for determination of starch and moisture were taken periodically by boring the stem. In the second experiment, two felled plants were cut into halves and kept in shade (25–30°) for a fortnight. The moisture and starch contents in these stems were determined at 3-day intervals. The results for starch content are given in Tables VII and VIII.

Table VII

Post-harvest variation in the starch content of stems allowed to remain standing in the field

Variety	Starch, % (dry wt. basis)		% loss
	Initial	After 1 week	
Rasbale	38·5	10·9	71·7
Maduranga	26·5	7·4	72·1

Table VIII

Post-harvest changes in the starch content of stems stored in the shade

Variety	Storage, days				
	0	3	6	9	12	15
			Starch, % (dry wt. basis)			
Rasbale	28·48	25·47	22·39	—	21·80	20·18
Maduranga	42·57	33·93	—	33·88	29·66	20·54
			Loss of starch, %			
Rasbale		10·6	21·4	—	23·4	29·1
Maduranga		20·3	—	20·4	30·3	51·7
			Loss in weight of stems, %			
Rasbale		9·3	12·8	19·9	24·1	27·3
Maduranga		8·5	12·0	18·2	22·3	25·5

(iv) *Effect of removing inflorescence and fingers on the content of starch.*—The object of removing the inflorescence and fingers as soon as they appeared was to induce the accumulation of starch in the growing plants. Twelve plants of variety *Rasbale* of practically the same age were selected. From four of these the inflorescence was removed and from four others the fingers; the last four were allowed to bear fruit to maturity in the normal way. At the harvest time of the control plants, samples of every stem were taken for moisture and starch determinations and for recovery of starch by crushing (Table IX). The calculated yield of starch per acre from some important varieties of banana is shown in Table X.

Table IX

Effect of removing inflorescence and fingers on the starch content of stems (4 plants in each case)

Treatment	Dry matter in individual plants, %	Starch content (dry wt.), %	Average starch content (dry wt.), %	Mean starch content (90% stem moisture basis)
Control*	8·2	26·0	27·4	2·70
	7·6	20·6		
	9·4	27·7		
	9·5	35·6		
Inflorescence removed soon after its appearance	14·1	49·5	44·2	4·42
	17·1	46·2		
	15·4	45·6		
	12·0	35·5		
Fingers removed as and when they appeared	16·7	37·9	36·0	3·60
	12·2	34·9		
	13·1	34·9		
	14·7	36·4		

* Harvested after rains

Table X

Calculated yield of starch (cwt./acre) from the stems of some important varieties under cultivation in Mysore State

Variety	No. of trees per acre	Average weight of stem, lb.	Average starch (fresh wt.), %	Yield of starch,* cwt. per acre
Rasbale	800	50	4·6	15·9
Maduranga	700	75	4·0	18·2
Pache-Bale	700	50	2·7	8·2
Putt-Bale	700	65	4·0	15·8
Salem-Bale	800	50	2·2	7·6

* On the basis of 97% recovery of starch

Composition and physical properties of the starch

The results of analysis of banana stem starch are given in Table XI. Fig. 1 shows the unstained starch granules and Fig. 2 the appearance of gelatinized starch granules.

Table XI

Chemical composition and physical constants of banana stem starch

	Sample A	Sample B
Moisture %	7·3	8·9
Starch % (i) by acid hydrolysis	91·27	89·49
(ii) by Taka-diastase	88·76	88·41
Ash %	1·33	1·52
Ash insoluble in conc. HCl %	0·38	0·32
Alkalinity of ash (ml. of N-HCl for 1 g. ash)	—	19·5
Solubility in water %	0·76	0·59
Gelatinization temp., °C	78	78
pH of aqueous suspension	6·45	6·70
Intrinsic viscosity in 1N-KOH at 35°	1·72	1·86

Reaction towards iron.—The banana stem possesses a strong oxidase system and also contains phenolic substances which on contact with iron give rise to grey discoloration. Since the equipment in which starch is handled is generally of iron, it was of interest to test the starch for any residual effects of the darkening constituents and oxidase action. For this purpose, 2% starch suspension in water was boiled for 15 minutes and placed in contact with iron in different ways, but in no case was discoloration observed.

Paste and size properties

The starch was found to be a thin-boiling one and formed clear pastes readily when boiled with water. No appreciable foam was produced during boiling and the cooled paste did not

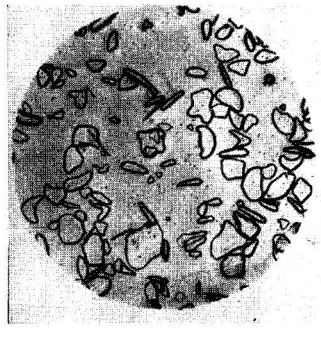

FIG. 1.—*Banana starch (unstained)* (× 90)

FIG. 2.—*Banana starch in water at* 70–72° (× 90)

easily form a surface skin. These are important attributes which determine to some extent the suitability of the starch for sizing. A bulk sample (80 lb.) prepared in the pilot plant was tested for sizing properties by the Textile Research Association Laboratory, Ahmedabad. The results are given in Table XII.

Table XII

Physical properties of grey yarn sized with banana stem starch (38s/42s, 96/56, *poplin*)

	% Size	Tensile strength, oz.	% Elongation at break	% Increase in tensile strength
38s *combed*				
Original	—	6·0	5·8	—
Sized, Beam 1	9·49	8·6	4·6	43·3
Beam 2	10·17	9·2	4·8	53·3
Average	9·83	8·9	4·7	48·3

(The beams worked quite satisfactorily in the loom shed)

Experimental slasher, 18s warp				
Original	—	10·8	6·6	—
Sized	7·81	15·5	5·6	43·5

Size mix: banana stem starch 56 lb.; tallow 6 lb.; water 86 gal. (Final volume 108 gal.)
Finishing paste: banana stem starch 15 lb.; Waxol P.A. 0·5 lb.; Alizarin 2 R.C. Special 8 g.; water to 20 gal.
% finish found in laboratory 3·03

Effect of alkali concentration on the viscosities of the starches of banana stem and maize

Aliquots of 0·5 g. of starch from banana stem and from maize were dispersed in NaOH solutions of 1 to 2% concentration, the volume being made up to 100 ml. with the alkali solution. Flow times of the resultant solutions, which were the same 10 minutes and 3 hours after the addition of alkali, were determined with an Ostwald Viscometer and are given in Table XIII. It will be seen that the concentration of alkali has no effect on the time of flow of the solutions.

Table XIII

Relative times of flow of alkali dispersions of the starches of banana stem and maize (0·5% *starch*)

Alkali concn. g./100 ml.	Time of flow, sec.	
	Banana stem starch	Maize starch
1·00	31	36
1·25	31	36
1·50	31	36
2·0	31	38

(Time of flow of water = 12 sec.)

Edibility of banana stem starch

A dry custard powder mix was made by gradual incorporation of a dispersion in 10 ml. of water of 1·2 g. of Edicol Sunset Yellow (I.C.I.) and 12 ml. of vanilla essence, with mechanical mixing, into 1 kg. of the banana stem starch and the mixture passed through a fine sieve.

Dishes made from this powder were more fluid than those made using an equal weight of maize starch, but consumer acceptability trials showed that they were of good quality.

Discussion

Factors affecting yield

For efficient recovery of starch, the stems require to be subjected to both crushing and tearing actions, as in a Waring Blendor. The emery wheel and rubber rasping machine based on principles of rasping and grating also proved satisfactory. The mode of action of the shredder does not lead to a good recovery of starch (Table II). The capacity, however, of the Waring Blendor and of the emery wheel are restricted, and the combination of cane crusher and paper pulp beater

was found quite satisfactory on a pilot-plant scale. Drying of the stems, no doubt, offers practical advantages in the collection and transport of the material but the starch is somewhat affected in colour and slightly contaminated by very finely ground pulp. Again, there may not always be sun for drying, and artificial dehydration of the material will add to the cost of manufacture. The recovery of starch from dried material, however, was satisfactory.

Data in Table I show conclusively that yield of starch varies considerably. On the fresh-weight basis, an average yield of starch in 50% of the stems tested was more than 2% and some samples even contained as much as 5·0% starch.

A number of factors may be involved in influencing the starch content of the stems, such as variety, stage of growth and environmental conditions. Tables III–V show that formation of starch in banana stem takes place during its growth and development. As the young sucker matures into a fruiting plant, the starch content increases, the maximum content appearing at the harvesting stage.

Varieties collected from orchards in Mysore differed in their starch content from their counterparts grown in orchards in Madras State. Data indicating varietal and regional variations in starch content of the stems (Table VI) are of particular importance. Differences in starch content were observed also in the same variety grown in different gardens, and also within a garden when grown and harvested at different times of the year. Mean starch content of the variety *Monthan* tested at Aduthurai during July had 0·5% starch whereas during September it had an average of 2·1%. Soil, cultural practices and climatic conditions appear to play an important rôle in the formation of starch in the plants. In the hot climate of Aduthurai and other places in Madras State during June and July, starch formation seems to be low, or perhaps the starch undergoes some secondary change under the unfavourable climatic conditions. Higher starch content of plants in Mysore State is probably due to moderate climatic conditions. One of the factors responsible for the observed variations in the yield data (Table I) may probably be seasonal and climatic variations.

Among different varieties, *Poovan* grown in Madras and Mysore States has proved to be a poor source of starch as compared with *Rasbale* and *Maduranga*. Another important factor which indirectly influences the starch yield is the moisture content of the stems which varies widely. Two plants having 85–95% moisture may be found to contain 6% and 2% starch, respectively, but when the results are computed to the same moisture level, e.g., 85% moisture basis, the second plant would also show 6% starch content.

As seen in Table VII, more than 70% of starch originally present in the stems of freshly harvested plants is lost when the plants are kept for a week in the field. The results of storage experiments in the shade show that during the first 3 days 10–20% of the starch is lost. It is therefore necessary that the plants be transported to the factory immediately after harvest and processed forthwith.

Table IX demonstrates that the starch content of the stem increases as a result of removing the inflorescence as soon as it appears and allowing the plant to remain in the field till the harvest. The starch content of the stem from which the inflorescence was removed was 44·2% (on dry-weight basis) as against 27·2% in the control stems. The practical possibilities of banana stem as a source of starch are further shown in Table X.

Properties and uses of the starch

The starch has the general characteristics of starches at present being used commercially and is roughly classified as intermediate in its physical properties between cereal and tuber starches. It contains both amylose and amylopectin fractions, and glucose is the main product of acid hydrolysis of starch as shown by chromatographic methods.

It is almost insoluble in water. The paste properties compared favourably with those of any other starch.

Consumer acceptability tests showed that the custard powder made from this starch is of good quality. That the custard powder preparation was, on an equal weight basis, slightly more fluid than that from maize starch is an advantage over the ordinary custards in certain culinary preparations.

Regarding the sizing properties of the starch, the following is an extract from the report of the Ahmedabad Textile Industry's Research Association (see also Table XII) : ' It was not possible to take extensive warp breakage data in weaving to evaluate exactly how the banana starch compared with ordinary sizing materials. However, the two beams sized with banana starch were observed regarding their working for a long period, and our opinion as well as that of the weaving master is very satisfactory. We also feel that this starch is excellent for use in finishing because it gives a transparent paste which makes the finishing more lustrous.'

Acknowledgment

The authors wish to thank Dr. P. C. Mehta, Head of the Chemistry Division, Ahmedabad Textile Industry's Research Association Laboratories, Ahmedabad, for a comprehensive report on the size characteristics of the banana stem starch.

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THE NATURAL AGEING OF FLOUR*

By RUTH BENNETT and J. B. M. COPPOCK

Since 1951 untreated and commercially treated flours of different extraction rates have been stored under temperate conditions for eight-month periods and periodically examined to ascertain the naturally occurring change in baking quality. Doughs were tested by physical methods and other data associated with flour testing obtained. An increase in flour water absorption required to make doughs of normal consistency was observed which in part can be explained by drying out of the flour on storage. A slight toughening in doughs prepared from the earlier untreated flour was evident and was associated with some improvement in bread quality up to storage periods of about 4 months. The change, however, was very much less than has generally been supposed and in no case was it comparable in extent to the improvement in flour produced immediately by commercial gaseous and/or powder treatment. The slight natural toughening of the doughs from treated flour was in some cases detrimental to bread quality. No significant change in the breadmaking properties of flour could be detected during the first few days after milling.

Introduction

Traditionally bread flour is said to improve with age when kept under temperate conditions and it is generally thought that it yields better bread after keeping for several months than within a few days of being milled. There are several ways in which flour may change on storage : (i) in moisture content, according to temperature and humidity conditions ; (ii) in its capacity to absorb water to give a dough of normal consistency ; (iii) in certain physical qualities, particularly those affecting dough elasticity and extensibility which are associated with breadmaking

* Read before the Food Group, 10 Oct., 1956

quality ; (iv) in colour, i.e., whitening through natural bleaching ;[1] (v) changes due to oxidative effects on the natural flour oil;[1, 2] and (vi) microbiological deterioration by factors such as moulds, bacteria, mites and insects.[1] It is not always clear, however, in which respects the changes, commonly referred to as improvement, precisely occur.

Previous work has included many of the above aspects of storage effects at keeping periods up to 10 years. In the present work, however, the flour has been examined only over the period of practical importance to the baker. Earlier workers[3] found an increase in water absorption by the flour and improvement in colour but little change in loaf volume, shape or texture on baking after several months' storage. Moisture content has been shown[1, 2] to affect the development of fat acidity—the higher the moisture content the greater the percentage of lipids hydrolysed and the poorer the baking quality after storage.

Experimental

Since January, 1951, four sets of tests—by both conventional dough-testing procedures and test baking experiments—have been made in this laboratory to follow the change in flour quality with time. The investigations have covered a number of flours milled in successive years and were begun in January, 1951 and again in August, 1952. The flours examined included both untreated and gaseous-treated 81%-extraction flour, the treated 1952 flour having a colour-grade figure of 6·2. Further experiments (July, 1953) included top-grade low-extraction flour (colour-grade figure 2·0) and 80%-extraction flours, each untreated and gaseous-treated, and (March, 1955) untreated and gaseous-treated flours with colour-grade figures 3·7 and 2·7 and therefore of about 74% extraction. These covered the period of transition from gaseous treatment by agene to treatment with chlorine dioxide. Flours were stored in sacks or bins and in certain of the tests storage conditions were varied as indicated later. The age of the flour from the time of being milled to dough testing and test baking varied from 4 hours to 8 months. Data obtained included moisture, protein, and maltose contents, colour and water absorption values, dough quality tests by Brabender Extensograph, Chopin Alveograph, and Simon Extensometer methods, and baking tests at all stages under similar and controlled fermentation and baking conditions.

In the first two investigations (1951 and 1952) the untreated flours gave small squat loaves with honeycomb texture and this character, typically different from that of the loaves from treated flour, was retained throughout the period of examination. In the 1953 flours, the untreated 81%-extraction flour again yielded loaves considerably smaller and with more open crumb than those from the treated flours, but the untreated top-grade flour gave bread little different in volume or texture from that obtained from gaseous-treated top-grade flour. The untreated flour of about 74% extraction (1955), however, gave bread almost equal in volume to the treated flour and the crumb was fairly fine.

Thus the tests have covered a range in flour quality from that common in the post-war years to the present standard which more resembles the pre-war flour quality. Prints of the bread made at different periods after milling illustrate the effect of natural ageing.

Results

The work on various flours may be summarized as follows:

(1) *Milled in January, 1951. 81%-extraction untreated and gaseous-treated flour*

Each flour was kept in its sack in a bin:

(*a*) in a constant temperature room at 80° F;
(*b*) in the laboratory at 60–70° F;
(*c*) in a store at 40–50° F.

Fig. 1 shows the bread obtained from untreated and gaseous-treated flour which was a few days old and from the same flours 4½ months later at a time when the untreated flour gave its best bread and the treated flour was just starting to deteriorate.

The higher the storage temperature, the greater was the change in dough properties and baking quality, the dough showing some toughening. This change, however, even at 80° F, was small compared with the effect produced by gaseous or potassium bromate treatment of flour. At no stage in storage did the untreated flour give even approximately as good a loaf as did the treated flour even when only a few days old.

At storage temperatures of 40° F to 50° F little change in the flour was shown between 4 days and 6 months.

At 80° F the untreated flour changed somewhat more than the treated flour and there was a slight improvement between 2 and 4 months. The treated flour showed a significant deteriorative change only after 5 months, when bread prepared from it became progressively poorer.

(2) *Milled in August*, 1952. *81%-extraction flour untreated and gaseous treated*

These flours were kept in sacks in the laboratory store at 60–70° F. They were tested at 4–8 hours after milling, at 12 and 24 hours, at 1, 2 and 4 weeks, and then at monthly intervals up to 6 months.

Tables I and II give typical data obtained on the 1952 untreated and treated flours. Fig. 2 shows the bread made from flour kept for 4 hours, 24 hours, 4 months and 6 months.

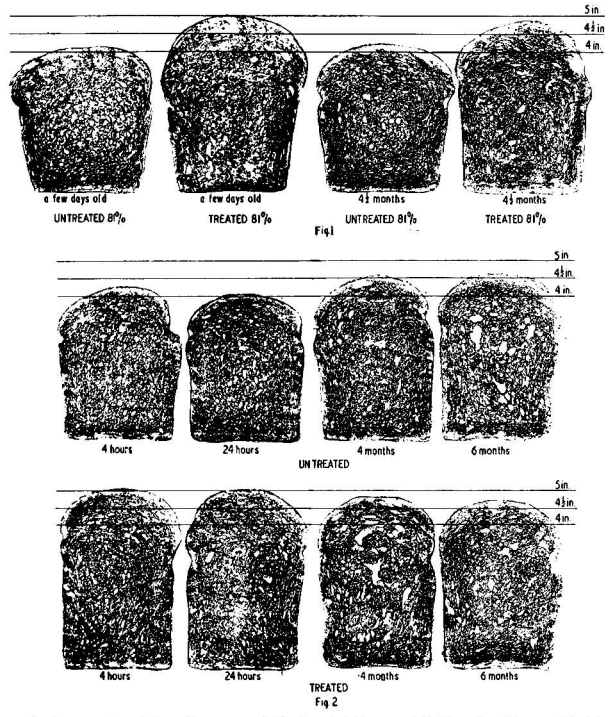

FIG. 1.—*Bread made from untreated and commercially treated flours of 81% extraction, milled in January 1951, and baked* (a) *a few days later and* (b) *after 4½ months' storage at about 69° F*

FIG. 2.—*Bread made from untreated and commercially treated flours of about 80% extraction, milled in August 1952, showing the change in each with time of keeping*

Table I

Tests on untreated flours milled 1952

Age	M %	Chopin								Simon			Brabender								Loaf height, in.
		Standard				Moulded							Farinograph		Extensograph						
		H	L	Area	L/H	H	L	Area	L/H	H_2	WA	Res.	Normal %	+ Salt %	45′ H	45′ L	90′ H	90′ L	135′ H	135′ L	
4–8 h.	14·8	84	85	31	1·0	67	104	38	1·5	22	15·0	400	17	61·3	59·5	260	19·5	270	20·4	250	19·6	4·4
12 h.	14·7	81	88	33	1·1	58	94	31	1·6	18	15·1	350	19	61·3	59·3	250	19·7	250	21·5	250	21·5	4·3
1 day	14·6	86	94	38	1·1	67	96	37	1·4	22	15·0	390	20	61·2	59·3	265	19·5	270	20·5	260	20·5	4·2
1 week	14·6	84	88	33	1·0	78	94	42	1·2	26	15·1	410	15·3	61·0	59·0	290	19·2	320	19·0	290	18·5	4·4
2 weeks	14·2	81	91	36	1·1	62	110	37	1·8	19	15·1	470	14·6	61·0	59·2	310	19·5	320	19·5	300	19·5	4·9
4 weeks	14·2	92	81	40	0·9	73	89	36	1·2	26	15·6	420	19	61·0	59·1	290	18·0	280	19·2	280	18·5	4·3
8 weeks	14·1	94	78	39	0·8	89	82	45	0·9	35	16·3	390	17·7	61·7	59·7	320	18·3	360	19·0	360	18·0	4·4
3 months	13·8	93	88	44	0·9	77	100	42	1·3	26	16·0	450	17·5	62·7	60·3	320	18·5	385	18·5	340	18·0	4·6
4 months	13·6	104	74	41	0·7	92	90	45	1·0	33	16·6	480	16·0	63·7	61·7	340	20	360	19·3	370	21·0	4·7
5 months	13·1	102	76	40	0·7	103	84	50	0·8	37	17·0	420	18·5	66·0	63·0	330	18·5	370	20·5	360	21·5	4·8
6 months	12·6	103	77	42	0·7	115	72	50	0·6	50	17·1	460	12·2	65·3	62·8	330	17·5	390	17·5	400	19·5	4·8

Zeleny Sedimentation Test: at 4-8 h. 46; at 6 months 44; Protein (N × 5·7): at 4–8 h. 11·3%; Maltose (Blish and Sandstedt): at 4·8 h. 4·1)

Key to abbreviations in Tables

M Moisture (15 min. at 155°, Carter Simon)
H Height of curve
L Length of curve
H_2 Height of curve at the point of breakage
WA Water absorption, gal./sack (1 gal./sack = 3·5%)
Res. Resistance
Ext. Extensibility

Table II

Tests on treated flours milled 1952

Age	M %	Chopin									Simon			Brabender								Loaf height, in.
		Standard				Moulded					WA	Res.	Ext.	Farinograph		Extensograph						
		H	L	Area	L/H	H	L	Area	L/H	H_2				Normal %	+ Salt %	45′ H	45′ L	90′ H	90′ L	135′ H	135′ L	
4–8 h.	14·7	101	82	42	0·8	138	59	60	0·4	72	15·1	580	12	60·8	59·0	390	18	440	18·5	465	16·6	5·1
12 h.	14·8	95	78	39	0·8	>145	—	—	—		15·2	580	12	60·8	58·8	385	18·5	440	16·5	510	16·8	5·2
1 day	14·7	98	91	49	0·9	>145	—	—	—		15·0	550	11·5	60·8	58·8	400	18·0	510	17·5	500	17·0	5·2
1 week	14·6	96	84	41	0·9	130	64	58	0·5	60	15·2	610	9·5	60·5	58·6	400	17·2	530	16·0	545	16·0	5·3
2 weeks	14·0	94	87	43	0·9	132	66	62	0·5	66	15·2	600	10·6	60·7	58·8	410	17·0	500	16·0	540	16·5	5·2
4 weeks	13·8	100	82	45	0·8	>145	—	—	—	—	15·7	580	12·3	61·5	59·5	390	18·2	470	17·0	450	16·5	5·2
8 weeks	14·0	112	79	52	0·7	>145	—	—	—	—	16·5	500	12·0	61·7	59·7	430	17·0	560	15·5	580	16·5	5·1
3 months	13·2	97	87	45	0·9	>145	—	—	—	—	16·1	610	13·0	62·5	60·3	420	17·5	580	18·5	570	17·5	5·2
4 months	13·2	115	80	48	0·7	>145	—	—	—	—	16·5	620	12·0	64·4	61·7	440	18·0	530	16·0	570	17·0	4·9
5 months	13·0	112	80	48	0·7	>145					16·7	620	11·0	65·8	63·0	410	17·5	530	17·0	560	18·0	5·2
6 months	13·0	117	73	48	0·6	>145					16·8	600	10·8	64·8	62·2	420	17·5	560	16·0	600	17·5	4·9

Zeleny Sedimentation Test: at 4–8 h. 39; at 6 months 38; Protein (N × 5·7): at 4–8 h. 11·4%; Maltose (Blish & Sandstedt): at 4–8 h. 4·1

(Abbreviations as in Table I)

No significant change in quality could be detected during the first 24 hours after milling. Thereafter, the main change was an increase in water absorption greater than could be accounted for by drying out of the flour.

Laboratory and baking tests confirmed the previous results, that the untreated flour improved with age to a maximum at about 5 months but that this change was trivial compared with the improvement caused immediately by gaseous or bromate treatment of the flour. The change in treated flour was shown only at about 5 months by a deterioration in bread quality due to over-toughening.

(3) *Milled in July*, 1953. *Top agitator flour and* 80%*-extraction flour both untreated and gaseous treated*

These flours were kept in sacks at 60–70° F. Each of the four flours was tested and baked 4, 12 and 24 hours after milling as well as at later periods up to 8 months.

Tables III and IV give the data for untreated and treated top-grade flour. (The 80%-extraction flour followed trends similar to those shown in Tables I and II.) Fig. 3 shows the bread made from tops untreated and treated flour at 8 hours, 24 hours, 9 weeks and 8 months.

As in the previous tests, no consistent change was detected up to 1 week after milling. Again, the flours dried out somewhat, but water absorption increased noticeably after about 8 weeks' storage—rather more than could be accounted for by the loss of moisture occurring during drying out ; this was the most significant effect found on storage up to 8 months. Slight toughening in the dough occurred, beneficial only in the untreated 80%-extraction flour, between 1 and 5 months. The changes in both the untreated and treated tops agitator flours and in the treated flour of 80% extraction showed only adversely in the bread.

As little support had yet been found for the alleged improvement by natural ageing of flour, a further test was carried out on a flour more similar in quality to pre-war flours.

(4) *Milled in March*, 1955. *Untreated and treated flours of about* 74% *extraction*

These flours were kept in bins at about 60° F and consequently they dried out less than flour kept in sacks. They had colour grade figures of 3·7 (untreated) and 2·7 (treated). The untreated flour gave much better bread than the untreated flours of the earlier tests and was almost as good as the treated flour tested a few days after milling. This is characteristic of many of the flours examined in 1955–56. Both flours gave their best bread at this stage. Tables V and VI give the results of this series. Fig. 4 shows the bread made several days after milling and after 2, 4 and 7 months' storage. Changes in water absorption were as previously described although there was less drying out. Dough quality changed very little. In bread made from untreated flour, good quality found during the first week was maintained up to 4 months' storage, after which slight deterioration set in. The treated flour gave measurably less volume in the bread as storage time increased. Up to 2 months it was slightly better than the untreated flour after which it deteriorated so that the untreated flour then became preferable.

Discussion

These tests leave considerable doubt as to whether natural ageing is, as generally accepted, significantly beneficial. Indeed the higher-grade (lower-extraction) treated flour is adversely affected in some respects by natural ageing. It was only in the high-extraction untreated flours that any beneficial effect was evident in the dough and in the bread, and even then the improvement was trivial compared with the immediate effect of gaseous or bromate treatment of flour.

There was, however, one significant effect of storage. The acid value of the lipids extracted from flour increased with the age of the flour from 18·4 in new flour to 39·6 (mg. of KOH/g. of flour oil) in flour six months old. The greater amount of lipid material in the high-extraction flour may be associated with the greater change in baking quality.

Flour may dry out depending on storage conditions, particularly in single sacks, and this may cause an apparent increase in water absorption. The fact therefore that aged flour absorbed more water may have been interpreted in the past as increased strength.

In so far as the additional water needed in doughing merely replaced that lost while the flour was in store, there was no gain to the baker. These tests have, however, shown a rather

Table III

Tests on tops untreated, 1953

Age	M %	Water absorption: Chopin Stand. %	Water absorption: Chopin Mould. %	Water absorption: Simon g./sack	Water absorption: Simon %	Water absorption: Brabender Normal %	Water absorption: Brabender + Salt %	Chopin: Standard H	Standard L	Standard A	Standard L/H	Chopin: Moulded H	Moulded L	Moulded A	Moulded L/H	Moulded H_2	Simon Extensometer: Res.	Simon Extensometer: Ext.	Simon Extensometer: Ext./Res. × 10	Brabender Extensograph 135′: Res.	Brabender Extensograph 135′: Ext.	Loaf height, in.
4 h.	14·4	51·1	56·1	15·6	55·7	60·5	58·2	90	66	36	0·7	72	85	38	1·2	31	41	13·8	3·4	420	16·6	5·2
12 h.	14·2	51·4	56·4	15·4	55·0	59·9	58·0	82	70	34	0·9	70	103	47	1·5	27	46	13·4	2·9	345	16·3	5·5
24 h.	14·2	51·3	56·3	15·6	55·7	60·8	58·6	88	80	39	0·9	71	80	37	1·1	29	49	14·7	3·0	420	18·0	5·3
1 week	14·1	—	56·6	15·7	56·0	61·0	58·9	—	—	—	—	70	89	37	1·3	30	42	13·0	3·1	420	17·2	5·4
2 weeks	14·2	—	56·3	15·6	55·7	61·4	59·2	—	—	—	—	70	104	43	1·5	20	50	13·4	2·7	445	18·7	5·4
4 weeks	14·1	51·6	56·6	15·8	56·4	61·4	59·3	92	80	40	0·9	66	87	35	1·3	27	46	13·5	2·9	430	17·2	5·1
8 weeks	13·6	—	57·4	16·5	58·9	—	—	—	—	—	—	80	91	42	1·1	33	48	10·0	2·1	—	—	5·3
3 months	13·5	52·6	57·6	16·3	58·2	62·7	60·6	85	79	37	0·9	87	83	37	0·9	38	54	12·0	2·2	390	17·6	5·2
4 months	13·0	—	58·5	16·7	59·6	63·2	62·0	—	—	—	—	75	82	39	1·1	31	46	11·0	2·4	390	16·8	5·3
5 months	12·8	53·9	58·9	16·6	59·3	64·6	63·5	91	81	40	0·9	80	96	44	1·1	34	51	10·8	2·1	340	19·0	5·0
6 months	12·4	—	59·6	16·8	60·0	64·5	63·6	—	—	—	—	81	90	50	1·1	38	48	11·8	2·5	380	19·0	5·4
7 months	12·2	—	59·9	16·9	60·3	67·6	65·1	—	—	—	—	92	78	46	0·8	43	51	12·2	2·4	390	18·4	5·2
8 months	10·4	—	63·1	17·8	63·6	68·5	66·5	—	—	—	—	92	80	48	0·9	45	52	12·4	2·4	430	17·0	5·5

Protein (N × 5·7) : 10·5%; Colour grade figure (CGF) : 2·0; Maltose (Blish & Sandstedt) : 2·7; Gas production : 230 ml. in 5 h.; pH at 20 weeks : 6·1

(Abbreviations as in Table I)

Table IV

Results on treated tops flour milled 1953

Age	M %	Water absorption: Chopin Stand. %	Water absorption: Chopin Mould. %	Water absorption: Simon g./sack	Water absorption: Simon %	Water absorption: Brabender Normal %	Water absorption: Brabender + Salt %	Chopin: Standard H	Standard L	Standard A	Standard L/H	Chopin: Moulded H	Moulded L	Moulded A	Moulded L/H	Moulded H_2	Simon Extensometer: Res.	Simon Extensometer: Ext.	Simon Extensometer: Ext./Res. × 10	Brabender Extensograph 135′: Res.	Brabender Extensograph 135′: Ext.	Loaf height, in.
4 h.	14·4	51·1	56·1	15·5	55·3	60·4	58·0	94	58	34	0·6	106	72	50	0·7	47	52	10·8	2·1	540	15·6	5·2
12 h.	14·4	51·1	56·1	15·4	55·0	60·0	57·8	94	67	38	0·7	93	82	52	0·9	44	51	10·5	2·1	460	15·4	5·4
24 h.	14·4	51·1	56·1	15·4	55·2	60·7	58·4	102	76	45	0·7	97	83	54	0·9	48	55	11·5	2·1	510	16·6	5·4
1 week	14·3	—	56·2	15·4	55·0	60·9	58·8	—	—	—	—	109	73	52	0·7	51	53	11·2	2·1	505	15·0	5·1
2 weeks	14·2	—	56·4	15·6	55·7	61·2	59·1	—	—	—	—	89	72	44	0·8	43	58	11·3	1·9	536	16·5	5·4
4 weeks	14·1	51·6	56·6	16·4	58·6	61·2	59·3	95	71	39	0·8	78	87	43	1·1	34	56	11·5	2·1	560	15·0	5·2
8 weeks	13·5	—	57·6	16·3	58·2	—	—	—	—	—	—	97	74	46	0·8	44	60	10·2	1·7	—	—	5·2
3 months	13·5	52·6	57·6	16·2	57·8	62·7	60·8	93	77	42	0·8	94	80	53	0·9	45	55	9·5	1·7	450	16·5	5·1
4 months	13·4	—	57·8	16·6	59·3	63·5	62·1	—	—	—	—	88	78	39	0·9	41	48	10·2	2·1	450	18·0	5·3
5 months	12·8	53·9	58·9	16·8	60·0	64·6	62·8	98	86	46	0·9	99	89	58	0·9	46	55	9·5	1·7	430	17·0	5·1
6 months	13·1	—	58·4	17·6	60·7	64·2	63·1	—	—	—	—	106	72	53	0·7	56	48	11·0	2·3	450	16·4	5·4
7 months	11·6	—	61·6	17·0	60·7	68·9	65·5	—	—	—	—	107	69	51	0·6	52	56	9·9	1·8	430	16·0	5·0
8 months	11·5	—	61·2	17·5	62·5	67·5	65·1	—	—	—	—	123	70	62	0·6	62	49	9·4	1·9	470	16·5	5·2

Protein (N × 5·7): 10·5%; Colour grade figure (CGF): 2·0; Maltose (Blish & Sandstedt): 2·7; Gas production: 227 ml. in 5 h.; pH at 20 weeks: 5·9

(Abbreviations as in Table I)

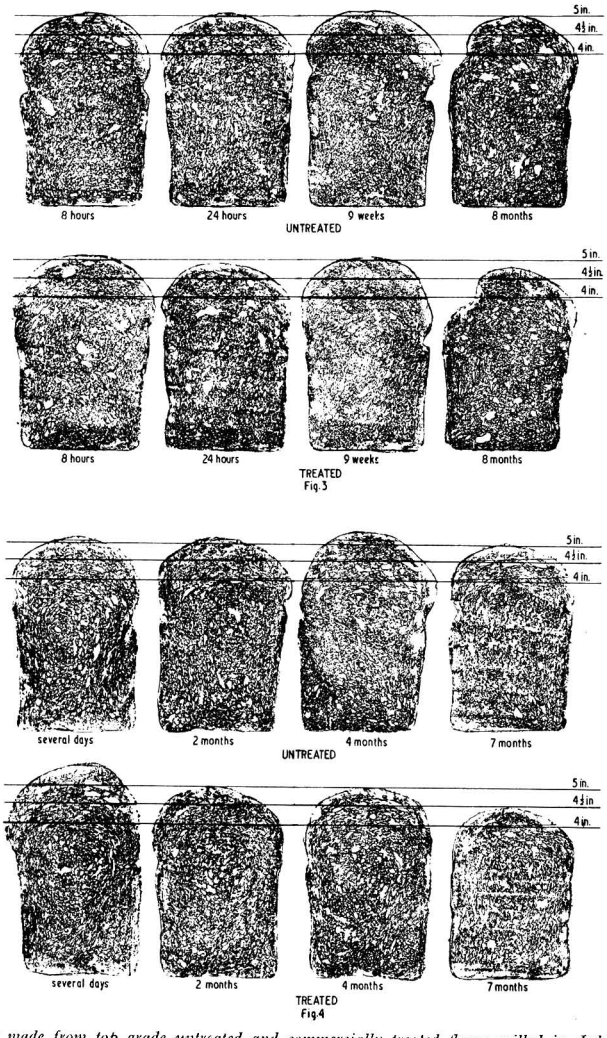

FIG. 3.—*Bread made from top grade untreated and commercially treated flours milled in July* 1953 *showing* (a) *similarity in the bread from untreated and treated flour and* (b) *negligible change up to* 9 *weeks followed by deterioration at* 8 *months*

FIG. 4. – *Bread made from untreated and commercially treated flours of about* 74% *extraction, milled in* 1955, *baked at intervals up to* 7 *months*

larger increase in water-absorbing power with age than can be entirely attributed to loss of moisture during storage and to this extent the flour can be said to have improved.

There is some slight whitening of untreated flour on storage, but again this is trivial compared with the bleaching effect of gaseous treatment. All the untreated flours could be readily picked out even after months of storage by the comparative yellowness of the crumb when baked.

Table V

Results on untreated flour milled 1955 (74% *extraction*)

Age	M %	WA g./sack	Res.	Ext.	Ext./Res. × 10	Loaf height,* in.
7 days	15·2	14·1	48	12·6	2·6	5·4
10 days	15·0	14·2	49	10·2	2·1	5·2
25 days			47	9·8	2·1	
2 months	15·0	14·8	53	10·7	2·0	5·2
3 months	14·6	15·0	46	11·5	2·5	5·3
4 months	14·5	15·0	42	12·0	2·9	5·2
5 months	14·5	15·2	36	10·4	2·9	5·4
7 months	14·8	15·1	44	11·5	2·6	5·2

Protein (N × 5·7) : 10·5% ; Maltose (Blish & Sandstedt) : 3·0 at 7 days; CGF : 3·7 ; Amylograph maximum viscosity : 70 flour/450 water, 250, at 74°.

* Average of three results

(Abbreviations as in Table I)

Table VI

Results on treated flour milled 1955 (74% *extraction*)

Age	M %	WA g./sack	Res.	Ext.	Ext./Res. × 10	Loaf height,* in.
7 days	15·2	14·1	53	9·2	1·7	5·6
10 days	15·1	14·1	46	9·1	2·0	5·5
25 days			48	9·3	2·0	
2 months	14·7	14·7	48	8·9	1·9	5·3
3 months	14·9	14·8	46	10·6	2·3	5·2
4 months	15·1	14·8	45	9·0	2·0	5·2
5 months	14·9	14·6	43	8·2	1·9	5·0
7 months	14·1	14·3	55	9·4	1·7	4·8

Protein (N × 5·7) : 10·6% ; Maltose (Blish & Sandstedt) : 2·7 at 7 days ; CGF : 4·6 ; Amylograph maximum viscosity : 210 at 72°.

* Average of three results

(Abbreviations as in Table I)

Apart from this it is difficult to see why so much importance has been attributed to such apparently little real improvement in untreated bread flour with age.

The only other possibility is that the flours of today are significantly different from those milled some years ago, owing either to variety or growth conditions or to the garnering of immature grain possibly associated with combine harvesting. For example, other work[1] has shown that the lipid fraction in flour has changed in quality during the past year. From the results now described, however, it does not appear that the effect of ageing in the 1955–56 flours is significantly different from that on the flours examined in the previous 3-year period, and it appears that the effect of natural ageing has probably been considerably exaggerated.

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SULPHUR IN SOILS.* II.—Determination of the Total Sulphur Content of Soil

By R. C. LITTLE†

Published methods for the determination of total sulphur in soil are reviewed. A method is described for determining total sulphur in soil in which all the sulphur is reduced to sulphide by heating the soil with ferrum reductum. The sulphide is treated with acid and the evolved hydrogen sulphide estimated iodimetrically with standard alkaline hypochlorite solution as absorbent. The method is specific for sulphur. It has been found applicable to the determination of sulphur in soils of widely diverse origins and in many kinds of pure substances, both organic and inorganic. An error of ± 2·5% can be expected in the determination of total sulphur in soil.

Introduction

The total amount of an element present in the soil gives an indication of the reserves of the soil, which could be changed by chemical or bacterial action into the available form. Sulphur is present in soil in many different forms, both organic and inorganic, and to ascertain its total amount it is necessary to change all the sulphur in these compounds into one form in which it can be subsequently estimated. For this purpose, soil can be treated either with a strong oxidizing agent thus oxidizing all the sulphur to sulphate, or with a reducing agent, whereby the sulphur is either driven off as hydrogen sulphide or left as a metallic sulphide which can be decomposed by dilute acid with the evolution of hydrogen sulphide.

Oxidation methods

Various techniques employing different oxidizing agents have been used to transform soil sulphur into sulphate.

The soil has been heated in a stream of oxygen[1] and the products of combustion passed over red-hot sodium carbonate. Fusion with single substances such as sodium carbonate,[2] sodium peroxide[3] or sodium nitrate[4] has been claimed to be sufficient to oxidize all the soil sulphur to sulphate, although some workers have preferred mixtures such as sodium carbonate and sodium nitrate[5, 6] or sodium carbonate and sodium peroxide.[7, 8] The Parr bomb has been used to facilitate the oxidation in soil,[9, 10] with inclusion of magnesium metal in the fusion mixture.

Other oxidizing methods have been suggested for determining sulphur in materials (such as rubber) less complex than soils, but no evidence has been found in the literature that these have been applied to the determination of total sulphur in soil. These methods entail the use of such reagents as Benedict–Denis reagent, Eschka mixture, perchloric and nitric acid, and hydrogen peroxide, with or without a bomb to facilitate fusion and oxidation.

The fusion melt is normally extracted with boiling water and the sulphate determined as the barium salt, but for this several techniques have been described. Some ions present in the solution may interfere with the gravimetric procedure and must be removed, e.g., silica by dehydration before precipitation of barium sulphate[2, 8, 10] or treatment of the barium precipitate with hydrofluoric acid,[6] and cations by passage of the solution through a resin exchange column.[3]

Reduction methods

Many authors have described methods for determination of sulphur in various materials by reduction to hydrogen sulphide,[11–28] sometimes after prior oxidation to sulphate. Among many reducing agents employed may be mentioned magnesium turnings,[11] hydriodic acid[12] and ferrum reductum.[13, 14, 28] The last method was used by Smittenberg *et al.*[28] for determination of sulphur in soil but they give no proof of the accuracy of the method. Johnson & Nishita[21] oxidized the sulphur present in plant material and soil by one of the accepted procedures and then reduced the sulphate formed with a mixture of red phosphorus, hydriodic acid and formic acid. Potassium hypophosphite can be used instead of the red phosphorus in this mixture.[20]

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The hydrogen sulphide obtained by reduction can be determined by several methods, e.g., colorimetrically by the stain produced on lead acetate paper,[28] iodimetrically direct,[23] or by absorption in a solution of zinc and/or cadmium acetate, the precipitate being determined iodimetrically.[11, 12, 15, 20, 28] Kitchener *et al.*[26] advocate the use of standard alkaline sodium hypochlorite solution for absorption of the hydrogen sulphide, which is stated to be a stoicheiometrically accurate method, although other authors[27] find that the pH and temperature of oxidation are important factors.

Choice of method

In view of the differences of opinion concerning the effectiveness and accuracy of the oxidation procedures and the best method for gravimetric determination of the sulphate formed and also because of the time that this gravimetric method requires (' quick ' methods for this are not satisfactory because of the complexity of composition of the solutions obtained from fusion melts of soil), it was considered that the reduction methods would provide a better approach to the problem. The use of ferrum reductum appeared to be the most attractive method and the procedure as briefly outlined by Smittenberg *et al.*[28] was used as a starting point to test its accuracy.

Qualitative tests showed that when such different compounds as potassium and calcium sulphate, sodium thiosulphate, sulphanilic acid and cystine were mixed with ferrum reductum and heated to redness in a combustion tube, the sulphur was converted to sulphide as shown by a lead acetate paper test on the gas evolved when the contents of the tube, after heating, were treated with dilute acid.

Two further points remained to be settled: (1) the development of a controllable method of heating the mixture of substance and ferrum reductum to obtain reduction of all the sulphur to sulphide with no loss by volatilization; and (2) choice of a suitably sensitive method of estimating the hydrogen sulphide set free by acidification of the resulting sulphide.

Examination of these problems led to (1) the establishment of a method of electrically heating the mixture which was found satisfactory for determination of the total sulphur content of many—and probably most—kinds of solid material; and (2) selection, testing, and verification of two techniques of absorbing and estimating hydrogen sulphide. One of these, in which zinc acetate was used as absorbent, was found satisfactory for determining the sulphur contents of pure compounds, including organic compounds such as methylene blue, and also suitable for estimating quantities of the order of 1 mg. of sulphur, such as would be contained in a manageable sample of sulphur-rich soil. The other technique—based on the use of hypochlorite solution as absorbent—was much more sensitive; it was capable of accurately determining quantities of sulphur as small as 0·1 mg. and thus made it possible to undertake total sulphur determinations on a 0·5-g. sample of any kind of soil including ordinary field soils containing no more than about 0·02% of total sulphur.

In the determination of sulphur in pure substances the amount of sulphur present was of the order of 2 mg.; but preliminary trials with soils showed that as 0·5 g. of a mineral soil was the normal charge for the tube, then the amount of sulphur to be determined might be as small as 0·1 mg.

It was therefore necessary to find, for use with soils, a highly sensitive method for the estimation of the hydrogen sulphide, i.e., one more sensitive than the zinc acetate technique which sufficed for the determination of sulphur in pure compounds. Colorimetric methods were considered but were thought to be too sensitive for the amounts of hydrogen sulphide envisaged; to determine 0·1 mg. of sulphur colorimetrically it would be necessary to take an aliquot of the zinc suspension for the colour development.

Kitchener *et al.*[26] found that, using 0·062N-sodium thiosulphate, the limiting sensitivity of their hypochlorite method for the determination of evolved H_2S was 0·0024 mg. of S, and they stated that 0·01% of sulphur in a 1-g. sample of iron could be readily determined correct to the nearest 0·001%, that is 0·1 mg. of sulphur in 1 g. of iron correct to the nearest 0·01 mg. S. Assuming 0·1 mg. of total sulphur is present in 0·5 g. of soil, this represents a total sulphur content of 20 mg. of S/100 g. of soil and the results would be correct to the nearest 2 mg. of S/100 g. of soil.

Kitchener and his co-workers[26] prepared 0·1N-sodium hypochlorite in 0·4N-NaOH by passing chlorine gas from a cylinder into 0·5N-NaOH until the required strength of sodium hypochlorite had been reached. Dunicz & Rosenqvist[27] passed chlorine, prepared by the action of hydrochloric acid on warm potassium permanganate, through a 0·15N solution of potassium hydroxide to give a solution of equal molarity (0·05) of potassium hydroxide, potassium hypochlorite and potassium chloride. The method described below for the preparation of the stock hypochlorite is, in effect, a combination of these two methods; it has been found very satisfactory.

Dunicz & Rosenqvist[27] preferred to keep the hypochlorite solution at 60° during the absorption of hydrogen sulphide and then to carry out the titration without further heating. Kitchener *et al.*,[26] however, found that satisfactory results could be obtained by boiling the hypochlorite, after absorption at room temperature.

As boiling was found to lead to consistent results, no study was made of the effect of varying the temperature during absorption. The findings of Kitchener *et al.*[26] that there was a slight, but very consistent, reduction in the titre of sodium thiosulphate when the sodium hypochlorite solution was boiled and cooled before titration, was confirmed for potassium hypochlorite.

Water reflux condensers have frequently been incorporated in the apparatus used in the determination of hydrogen sulphide liberated from sulphide by the action of acids. It was found by trial that a water reflux condenser could be dispensed with, provided that the connecting tube between the decomposition flask and the absorption flask was inclined sufficiently so that it would act as an air condenser. The dilute hydrochloric acid used was slightly weaker than the 1 : 1 hydrochloric acid used by Kitchener *et al.*[26]; it was also weaker than the constant-boiling mixture of hydrochloric acid and water. It was found that with the air-cooled condenser no acid fumes could be detected by a test paper placed over the end of the connecting tube.

In the method finally adopted, hypochlorite was used to absorb the hydrogen sulphide since it is of more general application than the less sensitive zinc acetate technique, although this was used for some pure substances.

The efficiency of the potassium hypochlorite solutions as media for the absorption of hydrogen sulphide was proved, in the absence of a reliable sulphide standard, by the determination of the sulphur content of pure potassium sulphate by the proposed technique. In proving the efficiency of the 0·02N-potassium hypochlorite a thoroughly prepared mixture of 10 g. of potassium sulphate and 90 g. of potassium chloride was used as the standard source of sulphur.

Experimental

Method

Reagents.—(i) *Ferrum reductum:* finely ground.

(ii) HCl: dilute 400 ml. of conc. HCl with 600 ml. of distilled water.

(iii) Potassium hypochlorite, stock solution: add 50 ml. of conc. HCl dropwise to 6·4 g. of potassium permanganate on a warm sand bath. With the aid of a stream of nitrogen, pass the chlorine gas evolved into 2 l. of 0·5N-KOH; the resulting solution should be approximately 0·1N in respect to potassium hypochlorite.

(iv) Potassium hypochlorite, approximately 0·02N: add 200 ml. of the stock potassium hypochlorite solution to 500 ml. of distilled water containing 18 g. of KOH and make up to 1 l. with distilled water.

(v) H_2SO_4, dilute: 50 ml. of conc. H_2SO_4 added to 450 ml. of distilled water.

(vi) Sodium thiosulphate, 0·02N: dilute 200 ml. of approximately 0·1N-sodium thiosulphate to 1 l. and standardize against 0·1N-potassium iodate solution.

(vii) Potassium iodate, 0·1N: dissolve an accurately weighed amount (approximately 3·6 g.) of potassium iodate AnalaR which has been previously dried at 120° for 2 h, in 1 l. of distilled water. (This is the primary standard on which the work is based and therefore great care should be taken in its preparation.) Calculate the exact normality from the weight taken, assuming that exactly 0·1N-potassium iodate contains 3·5677 g. of KIO_3/l.

(viii) Potassium iodide, 10%, stored in the dark or in a brown bottle.

(ix) Starch solution: make a paste of 0·25 g. of soluble starch with a little distilled water, pour the paste into 50 ml. of boiling distilled water and boil for 1 min. Allow to cool and add

about 0·25 g. of potassium iodide. The solution should be freshly prepared every 2–3 days.

(x) Nitrogen: compressed nitrogen gas can be used from a cylinder without further purification.

Apparatus

Combustion tubes.—Fused silica, transparent, 5 cm. long, 1 cm. bore, closed and rounded at one end (glass tubes are not satisfactory).

Heating blocks.—These were made up of two coils of 32-gauge nichrome wire embedded in heat-resisting cement (see Fig. 1). They were made from 5-ft. and 15-ft. lengths of wire to give coils of 1 cm. diameter and $\frac{1}{2}$ in. and $1\frac{1}{2}$ in. long respectively, and were embedded in a block of cement $3 \times 1\frac{1}{2} \times 1\frac{1}{2}$ in., care being taken that they were in line. The ends of the wire coil which extended through the cement were protected against overheating by wrapping with a few strands of low-resistance wire. The external wiring of the blocks is shown in Fig 1. The light bulbs are used as a variable resistance: the ammeter gave a full-scale deflection at 3·0 amp.

The top coil should give a temperature of 700° ± 50° after 10 minutes' heating, and when both coils have been in circuit for a further 10 minutes the temperature in the bottom coil should be 800°–900°; the temperature in the top coil at this stage should also be in the same range.

A typical performance of a silica-tube heating block was as follows: The top coil required a current of 1·3 amp. which was obtained by using as resistance three 100-watt bulbs and one 60-watt bulb (all in parallel) in the circuit described, with an a.c. supply of 240 volts; heating for ten minutes resulted in a temperature of 720°. When both coils were in circuit, four 100-watt bulbs were used to give a current of 1·2 amp. which gave a temperature in the bottom coil of 840° after 10 minutes' heating.

Apparatus for the determination of hydrogen sulphide.—Fig. 2 shows the apparatus used. The lower end of the gas inlet tube in the conical flask is drawn off to give a very fine hole. The height of the conical flask was adjusted so that when the glass tube was connected to the gas inlet tube, the former was inclined at about 15° to the horizontal. Connexions other than the ground-glass joints were made with polythene tubing. Silicone grease was used to lubricate the ground-glass joints. The flask was heated by means of a Gallenkamp sand bath of 900 watts loading with a three-heat switch.

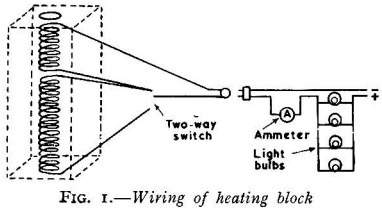

FIG. 1.—*Wiring of heating block*

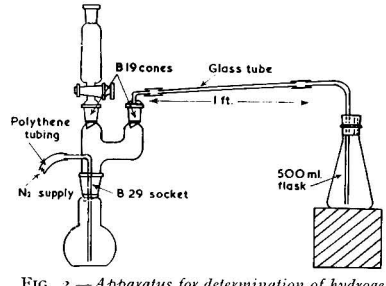

FIG. 2.—*Apparatus for determination of hydrogen sulphide*

Procedure

Preparation of the soil sample.—The soil to be analysed should be air-dried and milled to pass a 2-mm. sieve. Withdraw a 10-g. sub-sample of the soil by spreading the sample on a piece of paper and taking at least 20 small portions at random over the whole area. Grind this sub-sample in an agate mortar until it passes through a 60-mesh sieve, place the sieved material in a small bottle or tube (large enough to allow for mixing), and shake vigorously for several minutes to ensure thorough mixing.

Reduction with ferrum reductum.—Weigh exactly 1 g. of a mineral soil (0·5 g. if the loss-on-ignition exceeds 30%) on a watch glass by taking at least five small quantities from the container, stirring between each. Transfer the soil to an agate mortar, using a small brush to complete the transfer, and add exactly 5 g. of ferrum reductum. Grind the mixture for about 5 minutes to effect intimate mixing and apparent homogeneity.

Transfer about half of the mixture to a clean, dry, weighed silica combustion tube and reweigh. Add approximately 2 g. of ferrum reductum to the tube as a guard layer and weigh again. The tube is now ready for heating. [It is essential with pure compounds also, that the substance be well mixed with the ferrum reductum by grinding the two together in a mortar. (The weight of ferrum reductum should be about five times that of the substance and the amount added as the top layer about 2 g.)]

Insert the tube into the heating furnace so that the boundary between the mixture and the guard layer is slightly below the bottom of the top coil. The tube should be suspended in a stiff wire support so that its position in the block can be varied ; for, though the tube may be allowed to rest on the bottom of the block while the guard layer is being heated, the tube must be raised when the bottom coil is in circuit, otherwise the bottom of the tube will not reach the required temperature.

With the two-way switch set so that only the top coil is in circuit and the variable resistance adjusted to give the correct current, switch the current on and leave for 10 minutes. Then change the switch over so that both coils are in circuit, increase the current as may be necessary, and leave for a further 10 minutes. Switch off and allow the tube to cool.

Absorption of hydrogen sulphide.—Slip the combustion tube into the decomposition flask and assemble the apparatus on the sand bath ; the combustion tube should be lying as nearly horizontal as possible. Add 50 ml. of dilute HCl to the dropping funnel. Pipette 25 ml. of the 0·02N-potassium hypochlorite into a freshly rinsed conical flask and add 25 ml. of distilled water. Place the stopper carrying the gas inlet tube in position in the conical flask and attach the gas inlet tube to the connecting tube.

Switch on the sand bath to the ' medium ' position and, with the tap controlling the nitrogen supply closed, run in the acid from the dropping funnel ; as the acid runs into the decomposition flask, bubbles should be formed through the gas inlet tube (if bubbles do not appear, then one of the joints must be faulty and should be made air-tight). The hydrochloric acid attacks the ferrum reductum slowly at first, but bubbles soon issue from the gas inlet in the absorption flask.

When decomposition is complete, indicated by no further action on shaking the flask (usually after 30–45 minutes), pass nitrogen through the apparatus to sweep out all the hydrogen sulphide. Keep the rate of flow of nitrogen quite low for the first half-hour but for a further final half-hour increase the rate to give a steady flow of bubbles in the absorption flask. In order to make sure that all the hydrogen sulphide has been removed from the decomposition flask, break the connexion to the inlet tube and place a piece of lead acetate-impregnated filter paper over the end of the connexion-tube ; if no staining is observed, the transfer of hydrogen sulphide can be assumed to be complete.

Determination of the absorbed hydrogen sulphide (hypochlorite technique.)—Raise the stopper in the absorption flask by pushing the gas inlet tube a little further through the stopper. Boil the contents of the flask gently for exactly 5 minutes and then immediately cool to room temperature under running water. Add 5 ml. of 10% potassium iodide and 5 ml. of dilute H_2SO_4. Remove the gas inlet tube and wash it thoroughly, inside and out, with distilled water, collecting the washings in the flask. Titrate the liberated iodine with 0·2N-sodium thiosulphate adding, as indicator, 3 ml. of starch solution when the iodine solution has reached a very pale straw colour.

Carry out a blank titration on the hypochlorite by boiling 25 ml. of the potassium hypochlorite and 25 ml. of distilled water in a flask for exactly 5 minutes and titrate as above.

Calculate the results according to the following equation :

$$(B - T) \times F \times 16{\cdot}03/4 = \text{mg. sulphur absorbed},$$

where B = titre in ml. of 0·02N-sodium thiosulphate used in the blank titration,
T = titre in ml. of 0·02N-sodium thiosulphate used in the actual determination,
F = normality of sodium thiosulphate.

Carry out a blank determination of the amount of sulphur in the ferrum reductum by one of two methods: (1) directly on a known amount of ferrum reductum, or (2) by taking a known amount of potassium sulphate and adding a known amount of ferrum reductum to it, and assuming in the calculations that the potassium sulphate is completely reduced; this latter method has the advantage of giving a larger titration. Whichever method is chosen, the determination should be carried out in exactly the same way as described above. It is advisable when estimating the sulphur blank of, say, a 100-g. batch of the ferrum reductum, to grind the whole batch thoroughly to ensure that the blank will remain constant.

Calculate the total sulphur content of the soil, in mg. of S per 100 g. of soil, from the amount of sulphur found, less that in the ferrum reductum.

Discussion

In the method described by Smittenberg *et al.*[28] for the determination of total sulphur in soil it was suggested that the mixture of soil and ferrum reductum should be heated over a Bunsen burner. It has been found here that although acceptable results could be obtained in this way for pure inorganic substances, the results for organic substances were of the order of only 70% of the theoretical values. With most organic substances, considerable fuming occurred, and it was obvious that part of the sulphur-containing compound was being driven off before it had had time to react with the ferrum reductum.

It was to overcome the difficulty of effective heating that the electrical heating blocks, with silica tubes, were designed. The blocks were made so that the top part of the tube, containing the guard layer of pure ferrum reductum, could be heated to red heat before the bottom part of the tube containing the mixture was heated at all, and further, so that the top could be maintained at red heat while the bottom part was being heated.

Once the blocks were heating efficiently, i.e. once they were reaching the temperatures given, they could be used for the determination of sulphur in all kinds of compounds except the most volatile. The results of the analysis of pure substances, both organic and inorganic, are given in Table I. Visible fuming during the heating of organic compounds was almost eliminated, though it did occur in the heating of such compounds as methylene blue and sulphamezathine. Since complete recovery of sulphur added as methylene blue or sulphamezathine was consistently obtained, it was felt that the fumes could not possibly contain any sulphur and were therefore without much consequence. Fuming also occurred in the determination of the total sulphur content of soils (such as peats) which contained a high percentage of organic matter; these fumes were inflammable, and burned with a smokeless flame.

Accuracy of the method

The question of the effect of heating other ions, which may be present in soil, with ferrum reductum and the possibility of these ions interfering with the proposed method was considered. It was thought that only phosphorus, which might be reduced to phosphide giving phosphine with dilute acid, arsenic giving arsine and antimony giving antimony hydride, would be likely to cause interference. The effect of antimony was not investigated since antimony hydride is not stable even at room temperature.[30]

Ten mg. of arsenic added as arsenious oxide to a known amount of the potassium sulphate–potassium chloride mixture resulted in an increase of 25% over the expected value in the amount of sulphur recorded. One mg. of arsenic similarly increased the result by 15%. No interference was found in the determination of sulphur in the presence of 0·1 mg. of arsenic. Vinogradov[31] gave the mean arsenic content of 500 soils from seven different countries (not including Great Britain) as being 0·5 mg. of arsenic per 100 g. of soil; arsenic contents of as high as 2 mg. of As per 100 g. soil were reported for soils from regions of recent volcanic activity. This high figure is equivalent to 0·01 mg. of As in 0·5 g. of soil, i.e. only a tenth of the amount of As which was found to be without effect on the method for the determination of sulphur. As further proof that no arsenic was being absorbed by the hypochlorite solution, qualitative colorimetric tests for arsenic were made on the hypochlorite solutions used for absorbing the hydrogen sulphide from soils, only negative results being obtained.

Table I

Percentage of sulphur found in 'pure' substances

Compound	Formula	% Sulphur, calc.	% Sulphur, found	Difference as % sulphur
Potassium sulphate	K_2SO_4	18·39	18·34	− 0·05
Barium sulphate	$BaSO_4$	13·73	13·70	− 0·03
Calcium sulphate	$CaSO_4,2H_2O$	18·62	18·66	+ 0·04
Zinc sulphate	$ZnSO_4,7H_2O$	11·15	11·10	− 0·05
Sodium sulphite	$Na_2SO_3,7H_2O$	12·71	13·08	+ 0·37
Sodium thiosulphate	$Na_2S_2O_3,5H_2O$	25·83	25·44	− 0·39
Sulphur (commercial, roll, undried)	S	—	98·74	—
Methionine	$C_5H_{11}O_2NS$	21·49	21·58	+ 0·09
Cystine	$C_6H_{12}O_4N_2S_2$	26·68	26·36	− 0·32
Cysteine hydrochloride	$C_3H_7O_2NS,HCl$	20·34	19·72	− 0·62
Thiourea	$CS(NH_2)_2$	42·12	42·45	+ 0·33
Sulphanilamide	$C_6H_8N_2O_2S$	18·62	18·41	− 0·21
Sulphaguanidine	$C_9H_{10}N_4O_2S$	14·96	14·77	− 0·19
Thiobenzoic acid	$C_7H_6OS,\frac{1}{2}H_2O$	21·78	21·55	− 0·23
Mercaptobenzthiazole	$C_7H_5NS_2$	38·34	38·36	+ 0·02
Thioacetamide	C_2H_5NS	42·08	42·24	− 0·44
Trithioformaldehyde	$C_3H_6S_3$	69·56	69·03	− 0·53
Sulphamezathine	$C_{12}H_{14}N_4O_2S$	11·53	11·93	+ 0·40
Benzidine sulphone	$C_{12}H_{10}O_2N_2S$	13·02	14·12	+ 1·10
Diphenylthiocarbazone	$C_{13}H_{12}N_4S$	12·51	15·85	+ 3·34
Thiouracil	$C_4H_4ON_2S$	25·00	24·77	− 0·23
Methylene blue (hydrochloride)	$C_{16}H_{18}N_3SCl,3H_2O$	8·57	8·28	− 0·29

Note. Most of the above substances were of good, commercially pure quality, as sold; they were analysed without further purification.

The results are all averages of at least two concordant determinations.

Trithioformaldehyde was a preparation kindly supplied by Professor J. W. Cook; it is regarded as a difficult substance on which to estimate total sulphur by usual procedures. With the present method no difficulty or delay was experienced.

Phosphate (as sodium dihydrogen phosphate) had no detectable effect on the accuracy of determination of total sulphur when the phosphate was initially present in amounts up to the equivalent of 1% phosphorus (as P) in the soil. Since no ion, or substance, other than those tested, can be supposed to exist in humid soil in concentrations likely to cause interference with the proposed method for the determination of total sulphur, it may be concluded that the method is specific for sulphur.

In an attempt to prove that the proposed method was actually recording all the sulphur—in both organic and inorganic form—in soil, sulphur in suitable forms was added to various soils and the percentage recovery determined. The results of these determinations, which included the addition of sulphur in organic and in inorganic form, to soils of widely varying organic matter contents (as shown by the loss-on-ignition) are given in Table II. Sulphur in organic form was supplied as a methylene blue–starch mixture, containing 4 mg. of S per g. of mixture. Inorganic sulphur was added as the potassium sulphate/chloride mixture mentioned above.

Recovery of added sulphur was complete in all these determinations. This is taken as confirmation that the method is in fact recording all the sulphur in soil, whether the sulphur is present in organic or inorganic form.

It will be appreciated that the method recommended for soils, with its use of hypochlorite as absorbent, comes into the 'micro-analytical' class, since it is put forward for the accurate determination of quantities of sulphur of the order of 0·1 mg., or about 0·02% of total sulphur in a sample of 0·5 g. of soil. The derivation of a 'micro' method was not originally intended but it seems reasonable to use a 'micro' method for the determination of sulphur in soil, and, by extension, in any material which cannot readily undergo solution or other preliminary concentration to reduce the mass or volume of substance for analysis.

That micro-analytical techniques cannot always be regarded with favour in soil analysis is due to the heterogeneity of soil and the consequent difficulty of preparing small but representative sub-samples. Some micro-techniques are unjustifiable for soil on account of the impracticability

of preparing an unaltered small sample ; but for the determination of the total content of an element which exists in compounds not likely to be fugitive during preparation of a small but true sample it becomes admissible to use fractions of a gramme of soil. For example, Godfrey & Riecken[32] used 100 mg. of oven-dry soil in their determination of total phosphorus in Iowa and Missouri soils.

Table II

Recovery of organic and inorganic sulphur added to Scottish soils of various organic matter contents

Type of soil	Loss on ignition, %*	Original total S content, %†	Compound added	Sulphur added to soil, mg.	Recovered S, mg.	% Recovery
Peat	74·3	0·14	Methylene blue	0·852	0·855	100·4
,,	74·3	0·14	,, ,,	0·855	0·842	98·5
Garden	9·7	0·06	,, ,,	0·473	0·472	99·8
,,	9·7	0·06	,, ,,	0·469	0·477	101·1
Peat	74·3	0·14	Potassium sulphate	1·450	1·448	99·9
,,	74·3	0·14	,, ,,	1·473	1·480	100·5
Garden	9·7	0·06	,, ,,	1·477	1·454	98·4
Field	23·9	0·06	,, ,,	0·833	0·843	101·1
,,	23·9	0·06	,, ,,	0·728	0·718	98·6
Glasshouse	15·7	0·11	,, ,,	1·048	1·035	98·8
					Mean —	99·7

* Loss-on-ignition % of dry soil given as index of organic matter content
† On air-dry basis

In the present work, direct withdrawal of a 0·5-g. sub-sample from a sample of about 200 g. of soil which had been air-dried and milled to pass a 2-mm. sieve was found to give results which were in general agreement but which varied more from the mean value than had been expected. However, the proposed sampling technique gave results which were in close agreement with one another, especially where 1 g. of soil was weighed out and the mean of the two determinations carried out on this one weighing of soil was taken as one result.

Sampling trials were conducted in order to get an estimate of the errors involved in the sub-sampling of the different soil types. Statistical analysis of the results of these trials showed that in an agricultural soil (total sulphur content of agricultural soil used was 37·55 mg. of S/100 g. of soil) there was no significant error in taking the sub-sample from the main sample ; in the cases of peat and greenhouse soils the errors were $\pm$ 2·34 and $\pm$ 2·98 mg. of S/100 g. of soil (total sulphur contents 110·8 and 110·3 mg. of S/100 g. of soil, respectively). The standard deviations for the method as a whole, on the total sulphur content of the soil in question, were all found to be about 2·5%.

Conclusion

Using a set of four heating blocks, and four sets of apparatus for the determination of sulphide, it was found possible to maintain with ease and without assistance an output of eight completed analyses per day. Both the heating and the determination of the sulphide were operations which required only periodic attention ; consequently ample time remained for maintaining stocks of reagents and a supply of ground sub-samples. In time saved alone, the proposed technique offers many advantages over the oxidation methods, which require constant attention throughout some of their manipulations.

The method has been applied to the determination of the total sulphur content of various soils of different type and origin and no special difficulty was experienced with any of them. Results of a s rvey of soil contents of total sulphur and of readily soluble sulphate[33] will be discussed in a later paper.

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THE EFFECT OF DIETARY PENICILLIN ON CALCIUM AND NITROGEN RETENTION IN CHICKS ON A LOW MINERAL DIET

By W. O. BROWN

By the use of a balance technique for growing chicks fed a low mineral diet it is shown that a significant increase in calcium retention in the body is brought about by the addition of penicillin to the diet. The significance of this finding is discussed in relation to growth experiments with antibiotics and their mode of action in growth stimulation.

Introduction

Experiments designed to elucidate the mode of action of antibiotics have been concerned mainly with the conditions under which stimulation of growth is likely to occur (Coates *et al.*,[1]

Hill *et al.*[2]) and with the possible relationship of this stimulation to individual vitamin and protein deficiencies. Evidence is fairly strong in favour of a condition of ' infection ' in the animal, the alleviation of which, by these drugs, results in increased growth rates. That this is accompanied by an increased utilization of some of the B-vitamins may not be surprising when it is considered that the supply of such substances is intimately associated with the microflora of the alimentary tract.

Several workers[3–5] have demonstrated that increased utilization of certain B-vitamins accompanies antibiotic addition to the diet, but the inevitable complication of synthesis of some of these substances in the tract has ruled out any direct demonstration of increased absorption.

Whitewell *et al.*[6] showed that intravenous injection of penicillin or aureomycin produced no growth response, and similarly Becker *et al.*[7] obtained no responses from intramuscular injections in the pig. Unless one assumes a direct adverse effect on cellular metabolism resulting from a pathological condition of the animal which shows remission after a low level of dietary penicillin—an unlikely assumption in the light of the lack of growth response to large parenteral dosage—then it would seem reasonable to seek evidence for the response outside the body proper, namely, in the alimentary tract. Accordingly, benefit to the animal could result only from increased absorption or from increases in efficiency of metabolism resulting from the more complete absorption of some nutrient or nutrients.

Some progress has been made in the investigation of absorption effect by the study of antibiotic effects in deficiency conditions uncomplicated by synthesis. Investigations of the effect of antibiotics on the growth of chicks fed on low mineral diets have shown that responses to antibiotics are greater on such diets (Lindblad *et al.*[8]). Ross & Yacowitz[9] found increased tibia ash in chicks on a diet low in phosphorus which were given penicillin, and this observation is supported by the work of Migicovsky *et al.*[10] who showed a greater deposition of ^{45}Ca in the tibia of penicillin-fed chicks than in controls on a low calcium diet.

The results of Gabuten & Shaffner[11] showed that a low dietary level of penicillin in the laying hen increased blood calcium, whereas Sturkie & Polin[12] showed that the usual therapeutic dose administered parenterally had no such effect.

All the foregoing studies indicate that some significant effect on growth may be associated with the alimentary tract. The work described in this paper was carried out to examine whether, by a balance technique, differences in retention of calcium could be demonstrated in a chick receiving an antibiotic in a low-calcium diet.

Experimental

Day-old Light Sussex chicks as hatched were reared for ten days on a conventional chick mash and then placed in individual metabolism cages similar to those already described[13] but with a slightly modified feeder to eliminate food spillage.

The diet fed to the chicks in the cages was as follows : maize meal 63·5 lb., extracted soya-bean meal 29·0 lb., dried grass meal 2·0 lb., fish meal 3·0 lb., dried skim milk 2·0 lb., salt $\frac{1}{4}$ lb. The following vitamin and mineral supplements were all added per 100 lb. : $\frac{1}{2}$ lb. of vitamin A and D_3 concentrate containing 1200 i.u. of vitamin A and 300 B.S.I. units of vitamin D_3, 0·15 g. of riboflavin, 1·0 g. of nicotinic acid, 0·15 g. of KI and 1·0 mg. of vitamin B_{12}. Several samples from the diet as fed during the two experiments were analysed for Ca and N content and the weighted mean percentage figures for these two constituents were as follows :

Experiment 1—0·271% Ca, 3·678% N ;

Experiment 2—0·270% Ca, 3·890% N.

After five or six days when food intake was stabilized, 20 birds of comparable live weight were pair-fed on a scale allowing for live weight increase. Two balance experiments were carried out. Penicillin was fed at the rate of 20 mg. per kg. of diet. The usual balance procedure was employed and, since nitrogen was being determined, the faeces were collected into the Pyrex dishes containing oxalic acid as described in the earlier account of the cage.[13] In the first experiment blood samples were taken for the determination of serum calcium (Halverson's method). The birds were weighed at the beginning and end of the balance period (19 days) in each experiment.

Results and discussion

The results are given in detail in Table I and the analyses of variance of the results in Table II.

The experimental conditions proved suitable; none of the animals behaved abnormally, and daily paired feeding was carried out satisfactorily. In balance-work of this type it is essential that intake of control and treated animals can be equated from day to day. In experiment 2 the birds were slightly lighter at the commencement of the balance period than those in experiment 1, but gained more rapidly by virtue of their greater appetite. The controls consumed 480 g. per bird over the period compared with 400 g. per bird for the chicks in experiment 1.

Table I

Live weight increase, calcium and nitrogen retention and serum calcium levels in chicks (mean data)

	Experiment 1			Experiment 2		
	Control	Penicillin	Difference	Control	Penicillin	Difference
Initial live weight, g.	105	104	—	94	94	—
Live weight increase, g.	142	158	+ 16	191	206	+ 15
Calcium intake, g.	1·091	1·078	—	1·038	1·041	—
Calcium retention, g.	0·847	0·887	+ 0·040	0·705	0·758	+ 0·053
Nitrogen intake, g.	14·710	14·710	—	16·477	16·477	—
Nitrogen retention, g.	6·046	6·414	+ 0·368	5·943	6·477	+ 0·534
Serum Ca, mg./100 ml.	12·00	12·64	+ 0·64	—	—	—

Table II

Analysis of variance of live weight increase, calcium retention and nitrogen retention data

Source of variation	Degrees of freedom	Mean squares		
		Live weight increase, g.	Ca retention, g.	N retention, g.
Between treatments	1	2464·9	0·014089*	1·978440 N.S.
Between experiments	1	22372·9**	0·106308**	0·003846
Interaction	1	0·1 N.S.	0·000798 N.S.	0·084350
Between pairs within experiments	18	243·3	0·003062	0·618414
Error	18	238·1	0·002496	0·733225

** Significant at the 1% level
* Significant at the 5% level
N.S. Not significant

Considering the low mineral content of the diet, the growth rates were satisfactory (see Table I). The response to penicillin was significant (see Table II). This response is in agreement with the findings of other workers using diets containing sub-optimal levels of particular nutrients in feeding experiments. Such effects are reflected in the significantly greater feed efficiency of penicillin-fed animals in many reported experiments.

In the present experiment calcium was the nutrient fed at a very low level and the balance results are interesting. The inclusion of penicillin in the diet resulted in the very small increase of 4·7% in calcium retention in experiment 1 but in experiment 2 the increase was 7·5%. The mean response just attained significance at the 5% level. This increased retention of a nutrient such as calcium can be explained more easily than would a corresponding increase in the body reserve of some B-vitamin attributable to antibiotic supplementation. Such an effect could result from an increased absorption of calcium through the tract, or from a very much more efficient utilization of adsorbed calcium in the body, or a combination of both. There would appear to be little case for the direct involvement of an antibiotic in utilization of this element within the body. This is further supported by the recently reported experiment of Sturkie & Polin[12] in which parenterally administered penicillin was shown to have no effect on calcium metabolism in the pullet. The results of Migicovsky *et al.*[10] using ^{45}Ca in short-term experimentation are in agreement with the theory of an increased absorption of calcium after penicillin feeding.

The data for the blood-serum calcium obtained in the first experiment do not show any significant rise such as that reported in the laying hen.[11] The mean level in the antibiotic-treated birds was, however, slightly higher.

The nitrogen balance data were more variable and though the mean retention of nitrogen by the penicillin-fed chicks was greater than the controls, this difference was not significant ($P<0.2$) (Table II). Of the more recent work on the effect of antibiotics on nitrogen metabolism, the work of Forbes[14] on the rat appears to have been carried out most critically in respect of equalized planes of nutrition of controls and treated animals. Moreover, this investigator found that antibiotic addition to a soya-bean protein diet gave a 7·5% increase in nitrogen retention mainly attributable to decreased endogenous nitrogen excretion. In the second experiment reported here the increase in nitrogen retention was much greater than in the first, 11·1% as against 6·1% (see Table I). This increased retention could be accounted for to some extent by increased nitrogen needs of the slightly smaller birds of the second experiment.

The overall picture presented by these balance experiments supports the view that antibiotic addition to a low-calcium diet of a chick results in increased absorption of calcium and to an overall increase in live weight. The growth experiments of Lindblad *et al.*[8] have shown that inadequate levels of Ca and P in chick diets result in a greater growth response to antibiotics than of chicks on normal diets. The present data would tend to attribute such responses to increased retention of the mineral after antibiotic addition to such diets.

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ANIMAL FATS. VII.*—The Component Acids of Fats from Mouse, Porcupine and Rabbit

By F. D. GUNSTONE and W. C. RUSSELL

Information concerning rodent fats is extended to the component acids of mouse, porcupine and rabbit fats. Whereas mouse and rabbit fat accord with the general features of rodent fat composition, porcupine fat differs from the general pattern in several respects.

Introduction

Rodent fats have not been widely studied, quantitative investigations being restricted to fats obtained from rats, rabbits,† and guinea pigs. Continuing the investigation of animal fats this paper describes the component acids of three rodent fats: mouse, porcupine and rabbit.

Experimental

Mouse fat

The mouse fat used was the abdominal fat taken from about 80 mice of both sexes of a strain selected for large size (*Mus musculus*). Their diet consisted of a variant of Aberdeen Rat Cake containing some white fish meal (5%) and some cod liver oil (1%). The material supplied (71 g.) gave 61 g. of fat when extracted; this was kept at 0° until investigated, during which time the iodine value fell only from 88·0 to 86·8.

The material was analysed by methods already described in previous papers. The mixed acids were separated by low-temperature crystallization into three fractions in which saturated, monoethenoid and polyethenoid acids respectively were concentrated; each fraction was then esterified and distilled and the small ester fractions so obtained examined in the usual manner. The results are set out in Table I.

Table I

Mouse fat

Characteristics

Fat: Iodine value 86·6 Sap. equiv. 286·8 Free fatty acid 3·8% (as oleic acid)
Mixed acids: Iodine value 91·6

Low-temperature crystallization

Fraction	Methanol at		Wt., g.	%, w/w	Iodine value
	− 60°	− 20°			
A	Insol.	Insol.	15·1	27·4	1·5
B	Insol.	Sol.	21·7	39·5	97·5
C	Sol.	—	18·2	33·1	159·6

Component acids (all values except in last column are % (by wt.) of total)

	A	B	C	Total	% (wt.)*	% (mol.)*
Myristic	—	0·19	—	0·19	0·2	0·2
Palmitic	24·14	1·88	0·51	26·53	26·7	28·5
Stearic	2·54	—	—	2·54	2·6	2·5
Hexadecenoic	—	2·43	3·16	5·59	5·6	6·0
Octadecenoic	0·56	29·09	5·91	35·56	35·8	34·7
Octadecadienoic	—	4·68	21·27	29·95	26·2	25·5
Octadecatrienoic	—	—	1·85	1·85	1·9	1·8
'Eicosenoic'†	—	0·95	—	0·95	1·0	0·8
Unsaponifiable	0·16	0·28	0·40	0·84	—	—

* Excluding unsaponifiable material
† Average unsaturation — 2·2H

* Part VI: *Biochem. J.*, 1955, **59**, 455

† Some zoologists consider that rabbits and hares are not very closely related to the other rodents and are therefore placed in a distinct order, *Lagomorphia* (*Duplicidentata*), the order *Rodentia* being retained for all other rodents. The two orders are placed together in an isolated cohort *Glires*.

Pure samples of palmitic and stearic acids were isolated, hexadecenoic and octadecenoic acids were shown to be the usual *cis*-Δ^9-acids by isolation of *erythro*-9 : 10-dihydroxy-palmitic and -stearic acids following oxidation with dilute alkaline potassium permanganate, and linoleic acid was identified as 9 : 10 : 12 : 13-tetrabromostearic acid. All samples had the correct melting point which was not depressed when the sample was mixed with an authentic one. Quantitative bromination of a suitable fraction showed the presence of linolenic (6·6%) and linoleic (68%) acids and these values compare well with those calculated from spectroscopic data (6·8%, 71%) after alkali-isomerization indicating that the octadeca-di- and -tri-enoic acids are largely linoleic and linolenic.

Porcupine fat

Fat from the kidney, lungs, heart, spleen and stomach wall of a female crested porcupine (*Hystrix cristata*) was obtained. After extraction, the fat was stored at 0° until investigated, during which time the iodine value fell from 54·4 to 50·3.

The material was analysed in the usual manner and the results are summarized in Table II. Samples of palmitic and stearic acid were purified, hexadec-9-enoic and oleic acids were identified by oxidation to the corresponding *erythro*-dihydroxy acids, and linoleic acid by bromination to tetrabromostearic acid. All samples had the correct melting point which was unchanged when the sample was mixed with an authentic one. Quantitative bromination of one fraction showed 42% linoleic acid compared with 60% determined spectrophotometrically, suggesting that linoleic acid is accompanied by other octadecadienoic acids. After alkali-isomerization there was spectroscopic evidence of a hexadecadienoic acid (0·5%) but as this was not confirmed by bromination it is best included with the monoethenoic C_{16}-acid (cf. Table IV).

Table II

Porcupine fat

Characteristics

Fat : Iodine value 50·3 Sap. equiv. 271·0 Free fatty acid 6·0% (as oleic acid)
Mixed acids : Iodine value 52·3

Low-temperature crystallization

Fraction	Methanol at		Wt., g.	%, w/w	Iodine value
	− 55°	− 20°			
A	Insol.	Insol.	43·7	46·5	0·8
B	Insol.	Sol.	23·0	24·5	79·6
C	Sol.	—	27·3	29·0	111·2

Component acids (all values except in last column are % (by wt.) of total)

	A	B	C	Total	% (wt.)*	% (mol.)*
Myristic	0·60	1·75	2·78	5·13	5·2	6·0
Palmitic	33·82	1·79	0·45	36·06	36·3	37·8
Stearic	11·64	—	—	11·64	11·7	11·0
Tetradecenoic	—[7]	0·10	1·41	1·51	1·5	1·8
Hexadecenoic	—	1·68	1·90	3·58	3·6	3·8
Hexadecadienoic	—	—	0·50	0·50	0·5	0·5
Octadecenoic	0·31	18·47	8·13	26·91	27·1	25·7
Octadecadienoic	—	0·59	12·91	13·50	13·6	12·9
Octadecatrienoic	—	—	0·48	0·48	0·5	0·5
Unsaponifiable	0·13	0·12	0·44	0·69	—	—

* Excluding unsaponifiable material

Rabbit fat

The sample of fatty material (165 g.) came from the abdomen of a medium-size albino-rex female rabbit (*Lepus cuniculus*) whose diet consisted mainly of bran, dried grass and similar vegetable material to which was added linseed cake (~8%). The fatty material treated as described before gave 152 g. of fat. This was stored at 0° until analysed ; the fall in iodine value from 89·2 and the increase in free acidity from 1·5% show that the fat has deteriorated slightly during storage.

The results of the analysis carried out by standard procedures are given in Table III. Owing to certain difficulties, arising probably from the oxidative deterioration of the fat, it has not been possible to distinguish fully between the mono-, di- and tri-ethenoid C_{18}-acids though the presence of oleic, linoleic and linolenic acids was demonstrated by the preparation of dihydroxy-, tetrabromo- and hexabromo-stearic acids respectively. (Such results as were obtained indicate that octadecatrienoic acid probably accounts for 5% of the acids while the remaining C_{18} unsaturated acids are evenly divided between mono- and di-ethenoid.) Palmitic and stearic acids were also isolated and hexadec-9-enoic acid was identified as *erythro*-9 : 10-dihydroxypalmitic acid.

Table III

Rabbit fat

Characteristics

Fat : Iodine value 76·9 Sap. equiv. 267·9 Free fatty acid 8·4% (as oleic acid)
Mixed acids : Iodine value 81·1

Low-temperature crystallization

Fraction	Methanol at		Wt., g.	%, w/w	Iodine value
	− 55°	− 20°			
A	Insol.	Insol.	32·3	29·1	1·2
B	Insol.	Sol.	33·3	29·9	85·5
C	Sol.	—	45·6	41·0	135·1

Component acids (all values except in last column are % (by wt.) of total)

	A	B	C	Total	% (wt.)*	% (mol.)*
Myristic	0·13	1·29	1·21	2·63	2·6	3·1
Palmitic	22·71	2·25	—	24·96	25·1	26·5
Stearic	5·56	—	—	5·56	5·6	5·3
Arachidic	0·36	—	—	0·36	0·4	0·3
Tetradecenoic	—	—	2·21	2·21	2·2	2·6
Hexadecenoic	—	1·53	4·42	5·95	6·0	6·4
'Octadecenoic'†	0·29	24·74	32·76	57·79	58·1	55·8
Unsaponifiable	0·05	0·09	0·40	0·54	—	—

* Excluding unsaponifiable material
† Average unsaturation for the total unsaturated C_{18}-acids is − 3·0 H

Discussion

The results are summarized in Table IV along with figures previously reported for other rodent fats.

Table IV

*Component acids (% by wt.) of some rodent depot fats**

	Iodine value	Saturated				Unsaturated				
		C_{14}	C_{16}	C_{18}	(Total)	C_{16} (−2·0 H)	C_{18} (−2·0 H)	C_{18} (−4·0 H)	C_{18} (−6·0 H)	C_{20-22}
Porcupine	50·3	5	36	12	(53)	4	27	14	1	—
Rat[1]	57·3	7	24	5	(36)	6	49	5	—	1
Rat[2]	62·5	3	27	4	(34)	16	47	2	—	—
Rabbit (tame)[3]	66·3	4	29	4	(39)	7	37	12	2	2
,, [3]	72·3	6	31	5	(42)	6	32	16	3	1
,,	76·9	3	25	6	(34)	6	58 (−3·0 H)			—
(wild)[4]	—	2	22	6	(31)	4	13	8	42	1
Guinea pig[5]	—	5	19	6	(32)	2	36	19	1	9
Mouse	86·8	—	27	3	(30)	6	36	26	2	1

* Where the values do not total 100% this is due to the presence of other minor component acids

The total content of saturated acids, though rather variable, generally lies within the range of 30–40% ; this is largely palmitic acid (25–30%) with smaller quantities of myristic and stearic acids (each 3–6%). The unsaturated acids (60–70%) consist mainly of C_{18}-acids (50–60%), the balance being made up of hexadecenoic acid (4–6%) and small quantities of C_{20-22}-acids. The variation of iodine value from 57 to 87 (porcupine fat of iodine value 50 differs from the general pattern and is discussed below) is reflected chiefly in the relative amounts of mono- and di-ethenoid C_{18}-acids and only to a minor degree in the content of saturated acids.

Deviations from this general pattern are shown by some samples of rat fat and of guinea pig fat, and larger differences are apparent in the fats from porcupine and wild rabbit. Some samples of rat fat, of which that of iodine value 62·5 quoted in Table IV is typical, contain a relatively high content (12–16%) of hexadecenoic acid. This is attained only when the diet contains less than 1% of fat ; with diets containing about 5% of fat the hexadecenoic acid falls to the more usual figure. Guinea pig fat appears to be unusual in its low content of palmitic acid and in the high proportion of C_{20-22}-acids ; the animals from which this fat was obtained were in the first stages of inanition and it is uncertain how far this may affect the fat composition. The nature of rabbit fat seems to be highly dependent on its diet and wild rabbits feeding largely on grass are able to incorporate into their depot fats the diethenoid and triethenoid C_{18}-acids present in grass.[4] Rabbits kept under laboratory conditions produce depot fat more typical of rodents.

The results for porcupine fat are very unusual and require special comment. This fat differs not only from the other rodent fats but also from all other main groups of animal fat. It is characterized by a high content of saturated acids (53%), both palmitic and stearic acids being higher than usual. The corresponding decrease in unsaturated acids occurs entirely in the content of oleic acid (27%), and the amount of C_{18}-dienoic acid (14%) is surprisingly high for a fat of relatively low iodine value. The large proportion of palmitic acid (36%) puts the porcupine fat along with the body fats of some Indian oxen and with elephant fat as the only animal fats containing more than 33% of palmitic acid. It remains uncertain whether the porcupine always elaborates this unusual fat or whether this particular result is abnormal.

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ANIMAL FATS. VIII.*—The Component Acids of Flamingo Fat and Antelope Fat

By F. D. GUNSTONE and W. C. RUSSELL

A quantitative investigation of the component acids of flamingo fat shows it to be similar to other bird fats.

A sample of antelope fat has been examined. This differs from other ruminant fats in its high iodine value which is reflected in an unusually low content of saturated acids and increased proportions of unsaturated acids.

The results of a study of flamingo fat and antelope fat, neither of which has been previously examined, are presented here as part of an investigation into the component acids of animal fats.

Flamingo fat

Experimental

A sample of flamingo fat from a fairly young adult bird (*Pheonicopterus chilensis*) was examined. The captive bird had fed on vegetable roughage from the bottom of a pond, together with worms and slugs and occasionally shrimps. Death followed fracture of a rib which tore the lung and caused haemorrhage. The fatty material was autoclaved and subsequently extracted with light petroleum as described in earlier papers in this series. The fat (68 g.) was kept at 0° until investigated and during this time there was no change of iodine value.

The fat was analysed by the standard procedure used previously and the results are summarized in Table I. The presence of palmitic and stearic acids was confirmed by the isolation of pure samples and that of hexadec-9-enoic, oleic, and linoleic acids by the preparation of the usual derivatives; mixed melting points with authentic specimens were satisfactory in all cases.

Table I

Flamingo fat

Characteristics

Fat: Iodine value 65·8 Sap. equiv. 283·0 Free fatty acid 4·2% (as oleic acid)
Mixed acids: Iodine value 67·9

Low-temperature crystallization

Fraction	Methanol at		Wt., g.	%, w/w	Iodine value
	− 65°	− 20°			
A	Insol.	Insol.	18·6	30·2	2·8
B	Insol.	Sol.	34·1	55·4	87·2
C	Sol.	—	8·9	14·4	131·5

Component acids (all values except in last column are % (by wt.) of total)

	A	B	**C**	Total	% (wt.)*	% (mol.)*
Palmitic	21·69	2·40	0·53	24·62	24·8	26·5
Stearic	7·66	—	—	7·66	7·7	7·4
Hexadecenoic	—	2·56	1·84	4·40	4·4	4·8
Hexadecadienoic	—	—	0·50	0·50	0·5	0·5
Octadecenoic	0·71	48·48	3·98	53·17	53·4	52·1
Octadecadienoic	—	0·86	6·17	7·03	7·1	6·9
Octadecatrienoic	—	—	0·22	0·22	0·2	0·2
'Eicosenoic'	—	0·88	0·97	1·85	1·9	1·6
Unsaponifiable	0·14	0·22	0·19	0·55	—	—

* Excluding unsaponifiable material
† Average unsaturation — 2·5 H

* Part VII: Preceding paper

Evidence for the existence of hexadecadienoic and octadecatrienoic acids in the fat rests solely on spectroscopic evidence after alkali-isomerization and for this reason it is preferable to include these polyethenoid acids with hexadecenoic and octadecadienoic acids respectively (see Table II). Quantitative bromination of a fraction rich in polyethenoid C_{18}-acids indicated the presence of linoleic acid (43%); this compares favourably with the spectroscopic data (linoleic 38%, linolenic 2·2%) and suggests that the octadecadienoic acid is almost entirely linoleic acid.

Table II

*Component acids (% by wt.) of some bird fats**

	Iodine value	Saturated C_{16}	Saturated C_{18}	Saturated (Total)	Unsaturated C_{16} (−2·0 H)	Unsaturated C_{18} (−2·0 H)	Unsaturated C_{18} (−4·0 H)	Unsaturated C_{18} (−6·0 H)	Unsaturated C_{20-22}
Grey Goose[1]	57·1	20	6	(46)	3	42	7	—	2
Emu[1]	65·8	18	10	(30)	2	62	5	—	1
Flamingo	65·8	25	8	(33)	5	53	7	—	2
Hen (Light Sussex)[2]	78·5	24	4	(29)	7	42	21	—	1
Ostrich[3]	80·4	25	6	(32)	6	40	17	4	—

* Minor amounts of arachidic and tetradecenoic acids have been omitted. The goose fat contained also lauric (12%) and myristic (8%) acids

Discussion

The results obtained in this investigation are compared in Table II with those previously reported for other bird fats. The characteristic features of bird fat composition have already been discussed[3] and the flamingo fat fits closely into the general pattern. Saturated acids, consisting mainly of palmitic acid, account for one third of the total and, apart from a little hexadecenoic acid (~5%) and C_{20-22}-acids (2%), the remainder (60%) is unsaturated C_{18}-acids. When this is compared with the more unsaturated fats from the domestic hen and the ostrich it is apparent that the variation in iodine value is reflected in the relative amounts of unsaturated C_{18}-acids.

Antelope fat

Experimental

Antelope fat was obtained from the abdomen of an antelope (*Tragelophus scriptus*) which had died from congestion of the lungs. This animal had been fed on maize, green vegetables and carrots. Extracted in the usual way, 224 g. of fat was obtained. This had an iodine value of 85·0 and free acid 10·1% (as oleic acid) but these values changed slightly during prolonged storage to the values given in Table III.

The material was analysed in the usual way and the results are summarized in Table III. Palmitic, stearic, hexadec-9-enoic, oleic, linoleic and linolenic acids were isolated or identified by the preparation of suitable derivatives. There is only spectroscopic evidence for the hexadecadienoic acid and in Table IV this has been included with the monoethenoid acid. Quantitative bromination of a fraction rich in polyethenoid C_{18}-acids indicated linoleic (3·2%) and linolenic acid (3·0%) in much smaller amount than that determined spectrophotometrically (5·7 and 6·4% respectively). This suggests that the C_{18}-dienoic and -trienoic acids are largely isomers of linoleic and linolenic acid.

Hartman *et al.*[4] have reported that the fats of pasture-fed ruminants are unique in containing *trans*-acids (3·5–11·2%). A *trans*-monoethenoid acid should concentrate in the least soluble acid fraction (A) and the infra-red absorption spectrum of an ester fraction of appreciable iodine value from this group has been examined but there was no evidence of the presence of *trans*-acids.

Discussion

The antelope belongs to the true ruminants (*Pecora*) along with oxen, sheep, goats and deer, and the compositions of the depot fats of these animals are compared in Table IV. It is

Table III

Antelope fat

Characteristics

Fat: Iodine value 83·6 Sap. equiv. 281·0 Free fatty acid 10·3% (as oleic acid)
Mixed acids: Iodine value 87·8

Low-temperature crystallization

Fraction	Methanol at −60°	Methanol at −20°	Wt., g.	%, w/w	Iodine value
A	Insol.	Insol.	30·8	25·4	4·6
B	Insol.	Sol.	42·3	34·9	87·5
C	Sol.	—	48·1	39·7	140·4

Component acids (all values except in last column are % (by wt.) of total)

	A	B	C	Total	% (wt.)*	% (mol.)*
Myristic	0·62	0·57	1·61	2·80	2·8	3·4
Palmitic	19·28	1·18	—	20·46	20·6	21·9
Stearic	3·79	—	—	3·79	3·8	3·7
Arachidic	0·38	—	—	0·38	0·4	0·3
Tetradecenoic	—	0·35	—	0·35	0·4	0·4
Hexadecenoic	0·05	0·96	7·36	8·37	8·4	9·0
Hexadecadienoic	—	—	0·23	0·23	0·2	0·3
Octadecenoic	1·10	29·87	9·12	40·09	40·5	38·8
Octadecadienoic	—	1·76	17·30	19·06	19·2	18·6
Octadecatrienoic	—	—	3·68	3·68	3·7	3·6
Unsaponifiable	0·18	0·21	0·40	0·79	—	

* Excluding unsaponifiable material

Table IV

*Component acids (% by wt.) of some ruminant fats**

	Iodine value	Saturated C_{14}	Saturated C_{16}	Saturated C_{18}	Saturated (Total)	Unsaturated C_{16} (−2·0 H)	Unsaturated C_{18} (−2·0 H)	Unsaturated C_{18} (−4·0 H)
Goat[5]	33·5	2	26	28	(62)	?	38	—
Deer[6]	35·5	4	25	35	(66)	3	25	3
Ox[7]	43·2	3	29	21	(54)	3	41	2
Sheep[8]	43·4	3	25	28	(56)	1	37	5
,,	49·1	3	28	16	(48)	1	47	4
Antelope	83·6	3	21	4	(28)	9	40	19

* Minor amounts of other acids have been omitted. Octadecatrienoic acid is present in deer fat (2%) and antelope fat (4%)

immediately clear that antelope fat differs from the others. The depot fats of ruminants are generally in the iodine value range 30–50 and more than half of the component acids are saturated. Palmitic acid is roughly constant (25–30%) and is accompanied by a small amount of myristic acid (2–4%), the balance being largely stearic acid, the amount of which varies inversely with the iodine value. Among unsaturated acids there are minor amounts of hexadecenoic (1–3%) and octadecadienoic acids (2–5%) and the remainder consists of oleic acid. The total amount of C_{18}-acids is fairly constant and changes of iodine value are reflected mainly in the varying proportions of oleic to stearic acid. Antelope fat differs from the other ruminant fats in almost every respect, its high iodine value, its low content of palmitic and stearic acids, and its unusually high proportion of hexadecenoic and octadecadienoic acids.

Shorland[9] has characterized the ruminants as largely having lost the power to deposit dietary fat. The surprising results obtained in this investigation can be explained in three ways: there is something abnormal about this particular sample of antelope fat, the antelope synthesizes a fat different from that of other ruminants, or the antelope unlike other ruminants lays down dietary fat as well as endogenous fat. Further speculation would be premature at this stage. The absence of *trans*-acids further distinguishes this fat from other ruminant fats.

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ANIMAL FATS. IX.*—The Relation between Composition and Iodine Value

By F. D. GUNSTONE and W. C. RUSSELL

Consideration of the composition of animal fats containing little or no $C_{20\ 22}$-acids (39 fats of iodine value 31–96 from 30 genera) suggests an empirical relation between the iodine value and the amount of each component acid. This relation is expressed mathematically and the general conclusions are stated.

Changes in iodine value are reflected almost entirely in the varying proportions of saturated, mono- and poly-ethenoid C_{18}-acids. The changes in the proportion of each of these in animal fats of iodine value 90 falling to 30 are parallel to changes which occur during selective hydrogenation of mixtures of stearate, oleate and linoleate.

' Stearic-rich ' depot fats appear to be produced only by ruminants, quasi-ruminants and ruminant-feeding animals.

Introduction

In earlier papers of this series fourteen component-acid analyses have been reported. The fats have varied in iodine value from 35 to 93 and the animals from which these have come have included representatives of the following types : amphibia, reptiles, birds, rodents, and herbivorous and carnivorous animals. The difficulty of obtaining samples of animal fats has been the reason for this rather arbitrary selection. Attention has previously been drawn to the lack of detailed information concerning animal fats,[1, 2] and although great gaps remain, satisfactory analyses are now available for a much wider range of animals than when this work was started. It may appear premature to produce detailed generalizations on the available results, but it seems

* Part VIII : Preceding paper

appropriate at this stage to comment on the suggestions already made, and to suggest further, that through a wide variety of animals, there is a relationship between the component acids present and the iodine value of the fat.

It is now recognized that the fatty acids laid down as triglycerides in an animal depot fat are obtained from fat present in the diet (exogenous) and/or arise by synthesis from carbohydrate and protein probably via a C_2-unit (endogenous). The nature of stored fat depends primarily on the relative amounts of endogenous and exogenous material and this varies with the type of animal, with its rate of growth, and on the quality and quantity of the dietary fat. The composition of the endogenous fat probably depends mainly on the kind of animal but that of exogenous fat varies with the nature and amount of dietary fat. Thus all fatty acids are not equally utilized for depot fats and some may be modified (e.g., hydrogenated) before being laid down.[3] It is further known that depot lipids are in a dynamic state: this term implies that lipid material is continually being withdrawn from the depots and replaced by fresh material, so that any individual triglyceride molecule does not remain long in the depot fat but, under normal conditions, is metabolized by the organism and replaced by another triglyceride molecule. However, so long as conditions, particularly the diet, remain constant, the composition of a depot fat probably does not vary greatly as a result of this continual change; equilibrium will be established and in most cases a depot fat analysis will measure the composition of the fat under these equilibrium conditions.

The clear distinction between typical fish oils and the solid tallows of the higher land animals has long been recognized and the obvious physical differences are clearly reflected in the component acid analyses. Several investigators have commented on the fact that the fats of amphibians, reptiles, rodents and birds, frequently fall between these two extremes and Hilditch[4a] has suggested a definite relation between fat composition and the position of the animal in the evolutionary scale of development. Thus 'the fats of the simplest and most primitive organisms are usually made up from a very complex mixture of fatty acids whilst, as biological development has proceeded, the chief component acids of the fats of the higher organisms have become fewer in number'. There is no doubt about the increasing simplicity in the composition of animal fats as one proceeds from lower to more highly organized forms of life, but Shorland[5] has interpreted the observations differently. He considers that these results follow from changes in the natural diet of different types of animals and from the varying extent to which animals use exogenous fat.

It will be shown in this paper that for many animals the composition of the depot fat is directly related to its iodine value, which itself varies with the kind of animal and with the nature of the diet. This relationship must be established, and its limitations made clear, before speculating on its possible significance. Attention has already been drawn to the fact that variations of iodine value in a *restricted* group of animal fats are reflected mainly in the content of saturated, monoethenoid and diethenoid acids;[4b, 6, 7] the range of animal fats to which this applies, is now extended considerably.

Results

Table I contains 39 reported analyses from 30 types of animals, the fats covering the iodine value range 31–96. This Table contains most of the analyses effected by reliable procedures apart from additional reports on some of the species included. It does not include those fats which contain appreciable quantities of C_{20-22}-acids, since the generalizations to be discussed do not extend to these higher acids. Four of the fats included in Table I (elephant, porcupine, goose and emu) are so clearly different from the others that they have been ignored in coming to the following conclusions. This point is discussed later. All the values given in the Tables and quoted in the text are % by wt.

Saturated and unsaturated acids

It is to be expected that the content of saturated acids should decline as the iodine value increases, and that the proportion of unsaturated acids should increase with iodine value. If, however, the values are examined more closely or plotted on a graph it is clear that, as the iodine value increases from 30, the content of saturated acids falls quickly at first and then more slowly.

Table I

Component acids (% by wt.) of some animal fats

Animal	I.V.	Saturated	Unsaturated	C_{16}	C_{18}	Others	Saturated			Unsaturated*			Reference
							C_{14}	C_{16}	C_{18}	C_{16}	C_{18}	C_{18}	
Ox	31·0	67	33	39	57	4	2	37	27	2	29	1	(4*f*)
Camel	35·1	64	36	32	57	11	6	29	27	3	26	3	(4*f*)
Deer	35·5	66	34	28	66	6	4	25	35	3	25	5	(4*f*)
Puma	38·8	54	46	35	55	10	1	22	27	13	26	2	(4*f*)
Lion	41·0	54	46	31	58	11	5	29	18	2	40	—	(4*f*)
[Elephant	41·7	58	42	49	40	11	7	44	7	5	27	7	(4*f*)]
Ox	43·2	54	46	32	64	4	3	29	21	3	41	2	(4*f*)
Sheep	43·4	56	44	26	71	3	3	25	28	1	37	6	(4*f*)
Cat	43·6	52	48	34	59	7	4	29	17	4	41	2	(4*f*)
Hippopotamus	46·2	53	47	29	67	4	2	27	22	2	39	5	(4*f*)
Sheep	49·1	48	52	29	67	4	3	28	16	1	47	4	(4*f*)
Tiger	49·2	49	51	30	68	2	1	22	25	7	39	4	(4*f*)
Kangaroo	50·1	46	54	28	62	10	5	26	14	3	46	3	(4*f*)
[Porcupine	50·3	53	47	40	53	7	5	36	12	4	27	14	(8)]
Pig	54·3	47	53	33	64	3	1	30	16	3	41	7	(4*f*)
[Goose	57·1	46	54	23	54	23	8	20	6	3	41	7	(4*f*)]
Rat	57·3	38	62	30	59	11	7	24	5	6	49	5	(4*f*)
Chimpanzee	58·1	40	60	35	59	6	2	30	7	5	45	8	(4*f*)
Pig	60·0	41	59	31	65	4	1	28	12	3	48	6	(4*f*)
Ceylon bear	60·3	35	65	39	55	6	3	29	3	11	51	1	(4*f*)
Rat	62·5	34	66	42	53	5	3	27	4	16	47	2	(4*f*)
Giant panda	64·8	39	61	30	64	6	5	26	7	4	45	12	(4*f*)
[Emu	65·8	29	71	20	78	2	1	18	10	2	62	5	(4*f*)]
Flamingo	65·8	33	67	30	68	2	—	25	8	5	53	7	(9)
Rabbit	66·3	39	61	36	55	9	4	29	4	7	37	14	(4*f*)
Human	67·4	37	63	32	59	9	6	25	6	7	45	8	(4*f*)
Human	68·9	35	65	29	66	5	3	24	8	5	47	10	(4*f*)
Puma	69·7	40	60	29	62	9	4	24	11	5	40	12	(4*f*)
Tiger	70·5	41	59	33	62	5	3	27	11	6	38	13	(4*f*)
Rabbit	72·3	41	59	36	56	8	6	31	5	6	32	19	(4*f*)
Python	73·0	33	67	24	69	7	1	20	11	4	47	12	(4*f*)
Baboon	77·0	28	72	22	73	5	3	19	6	4	54	13	(4*f*)
Hen	78·5	29	71	31	67	2	1	24	4	7	43	21	(4*f*)
Hen	79·7	30	70	33	66	1	1	25	4	7	43	18	(4*f*)
Ostrich	80·4	32	68	31	67	2	1	25	6	6	40	21	(4*f*)
Crocodile	80·5	35	65	33	58	9	3	27	5	7	34	20	(4*f*)
Antelope	83·6	28	72	29	67	4	3	21	4	9	41	23	(9)
Mouse	86·8	30	70	32	67	1	—	27	3	6	36	28	(8)
Horse	95·6	36	64	33	60	7	5	26	5	7	34	22	(4*f*)

* Unsaturated acids are monoethenoid except for the last column which is the sum of di- and tri-ethenoid C_{18}-acids

The change of rate occurs at an iodine value of about 60 and it is possible to outline two areas, one in the iodine value range 30-60 and the other in the range 60-90, within which the great majority of the observed values lie. These areas are given by equations 1*a* and 1*b* (Table II). The values so calculated have been compared with the observed results and the differences are given in Table III from which it is seen that 28 of the 35 observed values lie within the calculated ranges and the other seven differ by not more than two units.

Total C_{16}- and C_{18}-acids

Attention has previously been drawn to the fact that in the depot fats of land animals almost all the acids, other than palmitic, belong to the C_{18}-series[4c] and since the C_{16}-acids are present in fairly constant amount, the total content of C_{18}-acids should also be fairly constant. This is further borne out by the figures in Table I which suggest that the total content of C_{16}-acids is given by $32 \pm 4\%$ and of C_{18}-acids by $62 \pm 7\%$. These values are correct for 29 and 32 respectively of the 35 observed values. Acids other than those of the C_{16}- and C_{18}-series are present in various proportions and together seldom exceed 10%; myristic and the unsaturated C_{20-22}-acids occur most frequently.

Myristic acid

Most animal fats contain a small but variable amount of myristic acid and in most cases (29 out of 35) this lies in the range 1–5%.

Table II

Equations for calculating acid content

		I.V. 30–60		I.V. 60–90
Total saturated acids	(1*a*) ..	(98 − I.V.) ± 3	(1*b*) ..	(49 − 0·2 I.V.) ± 4
Total C_{16}-acids		32 ± 4		32 ± 4
Total C_{18}-acids		62 ± 7		62 ± 7
Myristic		1–5		1–5
Palmitic		27 ± 3		27 ± 3
Stearic	(2*a*) ..	(59 − 0·87 I.V.) ± 4	(2*b*) ..	(11 − 0·067 I.V.) ± 2
Hexadecenoic	(3) ..	.. 0·075 I.V. ± 2	(3) ..	.. 0·075 I.V. ± 2
Oleic	(4*a*) ..	.. 0·83 I.V. ± 4	(4*b*) ..	(80 − 0·5 I.V.) ± 4
C_{18}-polyethenoid	(5*a*) ..	.. 0·067 I.V. ± 2	(5*b*) ..	(0·9 I.V. − 50) ± 3

Table III

*Differences in component acids (% by wt.) between calculated and observed values**

Animal	I.V.	Saturated				Unsaturated†		
		C_{14}	C_{16}	C_{18}	(Total)	C_{16}	C_{18}	C_{18}
Ox	31		+ 7	− 1				
Camel	35	+ 1						
Deer	36			+ 3	(+ 1)		− 1	+ 1
Puma	39		− 2		(− 2)	+ 8	− 2	
Lion	41			− 1			+ 2	
Ox	43						+ 1	
Sheep	43			+ 2		− 1		+ 1
Cat	44							
Hippopotamus	46							
Sheep	49					− 1	+ 2	
Tiger	49		− 2	+ 4		+ 2		
Kangaroo	50							
Pig	54							+ 1
Rat	57	+ 2		− 1				
Chimpanzee	58							+ 2
Pig	60			+ 3				
Bear	60			− 2		+ 5		
Rat	63			− 1		+ 9		− 2
Panda	65							
Flamingo	66	− 1					+ 2	
Rabbit	66			− 1			− 6	+ 2
Human	67	+ 1						
Human	69							
Puma	70			+ 3	(+ 1)		− 1	
Tiger	71			+ 3	(+ 2)		− 3	
Rabbit	72	+ 1	+ 1		(+ 2)		− 8	+ 1
Python	73		− 4	+ 3				− 1
Baboon	77		− 5		(− 2)		+ 8	− 3
Hen	79							
Hen	80							− 1
Ostrich	80							
Crocodile	81						− 2	
Antelope	84		− 3					
Mouse	87	− 1						
Horse	96				(+ 2)			− 11

* Where no figure is given the observed value lies within the calculated range

† Unsaturated acids are monoethenoid except for the last column which is the sum of di- and tri-ethenoid C_{18}-acids

Palmitic acid

Hilditch[4d] has commented on several occasions on the fact that the amount of palmitic acid is fairly constant over a wide range of animals and has quoted the figure 25–29%. When amended to 27 ± 3% it is found that only 7 of the 35 observed values lie outside this range (see Table III).

Stearic acid

The amount of stearic acid present in animal fats varies over a wide range (3–35%). When the content of stearic acid is plotted against iodine value, it is clear that the proportion of this

acid falls rapidly as the iodine value increases from 30 to 60 and then declines much more slowly as the iodine value continues to rise. Again it is possible to prescribe certain areas within which most of the values are to be found. These are given by equations *2a* and *2b* (Table II) and although 13 of the 35 observed values lie outside the calculated range, 5 are only 1 unit too high or too low and only one is incorrect by more than 3 units.

Hexadecenoic acid

The more recent methods of analysis have shown that all animal fats contain small but variable quantities of hexadecenoic acid which tend to rise slightly as the iodine value increases. There is no indication of a change at iodine value 60 or thereabouts and the content of this acid is given by equation 3 over the complete range of iodine value being considered.

Oleic acid

Oleic acid is the most common acid in practically all the fats listed in Table I. Plotting the amount of oleic acid against the iodine value, it is seen that the amount shows a tendency to rise as the iodine value increases to about 60 and then to fall as the iodine value is further increased. Most of the values are correctly given by equations *4a* and *4b*, and of the 12 observed figures which lie outside this range, 8 are in error by only 1 or 2 units.

C_{18}-polyethenoid acids

For the purposes of this argument, octadeca-di- and -tri-enoic acids have been taken together as polyethenoid C_{18}-acids. When the figures are represented on a graph it is clear that the content of polyethenoid acids is low and variable within the iodine value range 30–60 but rises steeply as the iodine value increases from 60 to 90. The points are largely bounded by the area represented by equations *5a* and *5b*; of the 11 figures which lie outside the calculated range, 9 are in error by 2 units or less.

Discussion

In connexion with these figures the following points may be noted:

(i) It has been known for some time that in animal fats of iodine value less than 60, the proportion of all acids, other than oleic and stearic, is roughly constant and that the content of these two varies with the iodine value of the fat. This observation may be expressed mathematically though so far as the authors are aware this has not been done before. Among more unsaturated animal fats the various proportions of oleic and of polyethenoid C_{18}-acids account for the changing iodine value and it is possible to relate the content of each to the iodine value. This has been done in the equations given in Table II.

The agreement between calculated and observed values is considered close enough to be of some significance. Omitting the total content of saturated acids, six values are given for each of the 35 analyses (i.e., 210 in all); 155 of the observed values lie within the calculated range; 22, 14 and 8 values are incorrect by 1, 2 and 3 units respectively and only 11 are more seriously in error. It should be remembered that, if in any fat one acid occurs to an extent other than that expected, this change must be compensated by an alteration in the proportion of some other acid or acids, so the number of apparent discrepancies may be expected to rise fairly sharply. The figures given in Table III show that the agreement between observed and calculated values is more satisfactory for the fats of iodine value 30–60 than for those of higher iodine value.

(ii) The equations given in Table II have been obtained by plotting the experimentally observed values on a graph and outlining the smallest area which will enclose the maximum number of points. Sometimes slightly different areas could have been prescribed which would have given similar results, and the derived equations may have to be modified when a wider range of analyses is available. When the proportion of an acid varies with the iodine value, the necessary equation has always been given in the form $(a + b \times \text{I.V.}) \pm c$. The value of c has been kept as low as possible though many of the minor errors could have been eliminated by increasing this value.

(iii) Since fats are the products of complex changes within living organisms, *it is not expected that their composition will conform rigidly to a mathematical formula*, and the present equations are merely convenient ways of representing a range of values within which the observed value is most likely to lie. Although the main thesis of this paper is that there is some relation between the iodine value and the composition of an animal fat, the limits of this claim must be made clear. The value of c (the permitted variation from the calculated *mean* value) varies between $\pm$ 2 and $\pm$ 4 and where the content of acid is small the variation is large compared with this mean value. Thus, for example, the content of C_{18}-polyethenoid acids in fats of iodine value 30–60 varies from 0–4% (I.V. 30) to 2–6% (I.V. 60) so that the amount of this acid is almost independent of the iodine value over this range. The same holds for the proportion of stearic acid in fats of iodine value between 60 (5–9%) and 90 (3–7%).

(iv) These expressions are valid only for animal fats containing little or no C_{20-22}-acids and within the indicated range of iodine values. There is insufficient evidence to determine whether these equations would hold at lower or higher iodine values. Even within these limits four sets of results quoted in Table I (elephant, porcupine, goose and emu) have been omitted because these were obviously out of line with the general values. The extent of this deviation is shown in Table IV in which figures for baboon fat are also included, as these show a very poor correlation with the calculated values (see Table III). Of the 30 values quoted in Table IV, 20 differ from the calculated value and in 12 of these the error exceeds 2 units. It is of interest to inquire into the reason for these divergences. Goose fat contains a greater proportion (23%) of acids, other than those of the C_{16}- and C_{18}-series, than is usual (5–10%) and this will obviously affect the proportions of the remaining acids. These additional acids are mainly lauric (12%) and myristic (8%) and probably reflect the high content of coconut oil in the diet.[10] Elephant fat is known to be unusual in its high content of palmitic acid (44%) with consequent disturbance in the proportions of the other acids. The high content of palmitic acid in certain Indian ox depot fats (see Tables I and III) seem, however, to be accommodated without too great a disturbance of the other acids. The anomalous nature of the porcupine fat has been discussed previously[8] and it remains for further investigations to show whether the samples of porcupine, emu and baboon fat are typical of these animals, or whether, for reasons of diet or otherwise, these results are abnormal in some way.

Table IV

*Observed and calculated values for five animal fats showing a poor correlation between the two**

Animal	I.V.	Saturated acids				Unsaturated acids†		
		C_{14}	C_{16}	C_{18}	(Total saturated)	C_{16}	C_{18}	C_{18}
Elephant	42	7 (1–**5**)	44 (24–30)	7 (19–27)	**58** (53–59)	**5** (1–5)	27 (31–39)	7 (1–**5**)
Porcupine	50	**5** (1–**5**)	**36** (24–30)	12 (12–20)	**53** (**45–51**)	4 (2–**6**)	27 (38–46)	14 (1–5)
Goose	57	8 (1–**5**)	20 (24–30)	**6** (**6–14**)	46 (38–44)	3 (2–**6**)	41 (43–51)	7 (2–**6**)
Emu	**66**	1 (1–**5**)	18 (24–30)	10 (**5**–9)	29 (32–40)	2 (3–7)	**62** (43–51)	5 (6–12)
Baboon	77	3 (1–**5**)	19 (24–30)	**6** (4–8)	28 (30–**38**)	4 (4–8)	**54** (38–**46**)	13 (**16**–22)

* Calculated values are given in parentheses. For references see Table I

† Unsaturated acids are monoethenoid except for the last column which is the sum of di- and tri-ethenoid C_{18}-acids

(v) So far the generalization has been expressed by means of mathematical formulae. It is of value to restate it thus: Most animal fats which contain little or no C_{20-22}-acids consist, apart from small quantities of myristic acid (1–5%) and hexadecenoic acid (2–7%), of palmitic, stearic, oleic and polyethenoid C_{18}-acids. Of these, the amount of palmitic acid is fairly constant (24–30%) and changes in iodine value are reflected in the changing proportions of the C_{18}-acids. Animal fats in the iodine value range 30–60 differ somewhat from those of higher iodine value (60–90); the choice of the value 60 is somewhat arbitrary but the observed values indicate that a change occurs at about this value. In the more saturated fats the polyethenoid acids are present to a very limited and fairly constant extent (2–4%), whilst the amount of stearic acid rises and that of oleic acid falls in fats of decreasing iodine value. In the more unsaturated fats the content of stearic acid is fairly constant (5–7%), whilst that of oleic acid falls and that of

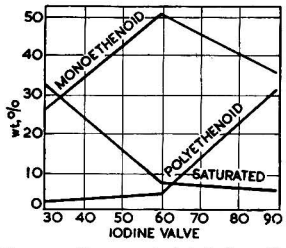

FIG. 1.—*Mean contents of C_{18}-acids plotted against iodine value*

polyethenoid C_{18}-acids rises as iodine value increases. These changes are shown in Fig. 1 where the mean calculated values of the C_{18}-acids are plotted against the iodine values. These lines represent the general tendencies revealed by the figures quoted in Table I and show a marked resemblance to the curves obtained when a mixture of stearate, oleate and linoleate in the proportion represented at iodine value 90 is selectively hydrogenated.

(vi) Animal fats have been divided into two groups, those of iodine value less than, and greater than, 60. This grouping, at first sight rather arbitrary, also corresponds to the separation of 'stearic-rich' and 'stearic-poor' animal depot fats, though, naturally, there is some mingling of these two groups in the iodine value range 55–65. More significantly this also divides the fats derived from ruminants, quasi-ruminants and ruminant-feeding animals from all others.

Apart from the unusual elephant, porcupine and goose fats (see iv) and those of rat and chimpanzee (of iodine value approaching 60) the remainder of the more saturated fats come from members of the *Ruminantia* (ox, camel, deer, sheep), from the *Suina* (pig, hippopotamus), considered by zoologists to be closely related to the *Ruminantia*, from a marsupial (kangaroo), a family which may have digestive processes similar to that of the ruminants (Moir *et al.*[11]), or from members of the *Felidae* (puma, lion, cat, tiger) the larger members of which feed largely on ruminants such as oxen, deer and goats. It is suggested[46] that the 'stearic-rich' ruminant fats result from the bio-hydrogenation of endogenous dioleopalmitins, and in view of the similarities between members of the *Ruminantia*, *Suina*, and marsupials it may be that all 'stearic-rich' depot fats are formed by a similar route or, as in the *Felidae*, result exogenously from a diet of animals which belong to this 'stearic-rich' class. It is fair to add that some members of these families can produce more unsaturated fats, e.g., wallaby, quokka and opossum (marsupials),[12] puma, tiger and antelope (Table I). Antelope fat, however, is unusual among ruminant fats;[9] the puma and tiger fats in question come from animals fed partly on horse flesh and horse fat is very different from that of the ruminants more usually eaten by these animals in their natural state.[7]

(vii) Hilditch and his colleagues[13, 14] have shown experimentally that pigs and sheep produce endogenous fat in which the ratio of palmitic acid to stearic and oleic acids combined is roughly 1 : 2 and they conclude that synthesized fat consists largely of palmito-di-C_{18}-glycerides. It now appears, however, that most land animals prefer to lay down depot fat consisting of about one-third C_{16}-acids (mainly palmitic) and two-thirds C_{18}-acids. These last may be saturated, monoethenoid or polyethenoid, and the relative amounts of each are directly related to the iodine value. In a fat of iodine value 60 the C_{18}-acids are largely oleic, with smaller amounts of stearic and polyethenoid acids. In fats of lower iodine value some oleic acid groups are replaced by stearic acid. In fats of higher iodine value some oleic acid groups are replaced by polyethenoid acids; at first these are mainly diethenoid but in the more unsaturated fats triethenoid material appears in greater amounts.

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THE EFFECT OF PHOSPHATE FERTILIZERS ON THE POTATO CROP IN SOUTH-EAST SCOTLAND

By K. SIMPSON

In sixteen field experiments carried out on the potato crop in south-east Scotland using different rates of superphosphate, little or no response in total yield was recorded except on four soils containing very little 'available' phosphate. Several of the experimental crops were riddled and the yields of ware, seed and chats recorded. On soils containing easily soluble phosphate at a level higher than 12 mg. per 100 g. of soil, the yields of ware and seed potatoes were not appreciably raised by increased levels of applied phosphate. In the low-phosphorus soils the maximum yields of ware and seed were reached at dressings of 5 and 10 cwt. of superphosphate respectively. The optimum rate of superphosphate was approximately 5·0 cwt. per acre for the low-phosphate soils, and 1·5 cwt. for the soils with higher available phosphate.

Introduction

It has long been established that spectacular increases in the yield of potatoes may be obtained on some soils by the application of phosphate fertilizers. The potato crop takes up phosphorus throughout the season and is capable of taking up luxury amounts of this element in both haulms and tubers.[1] Potatoes are widely grown in south-east Scotland and the normal farming practice is to apply, in the split drills, 12, 15, or even 20 cwt. of 'potato' fertilizer, equivalent to 5–9 cwt. of superphosphate in addition to dressings of 10–20 tons of farmyard manure per acre. It was felt that, on many of the more fertile soils, these dressings might be too high to be economical.

An investigation was therefore made between 1946 and 1955 with the following objects in view: (1) to assess the optimum rate of application of superphosphate for potatoes in terms of total yield; (2) to determine the effect of added phosphorus on the yields of the three size groups: ware, seed and chats; (3) to estimate, if possible, the limit of readily available soil phosphate at which no additional response to fertilizer phosphorus may be expected.

Experimental

Soils

The experimental sites were situated in the Lothians, where potatoes are grown regularly, usually once in a six-course rotation. The parent material of most of the soils was of glacial origin. At five centres the soil was a sandy loam derived from fluvio-glacial sands and gravels.

At nine other sites the parent material was heavy glacial till, and the top soil was medium or medium-heavy loam. The two remaining sites were based on alluvium and raised beach. All the soils had pH values within the range 5·5–6·5 with the exception of one with a pH value of 8·0. Samples of soil were taken from each plot on all the experimental sites for determination of ' easily soluble phosphate '. The solvent used for extraction of the soil phosphate was 0·2N-HCl;[2] 5 g. of soil were shaken with 20 c.c. of acid for 10 min. and set aside for a further 10 min. before filtering. The results were recorded as mg. of P_2O_5 per 100 g. of soil.

Treatments

Two preliminary experiments were carried out during the seasons of 1946 and 1948. In these the design was 5 randomized blocks each of three plots, with phosphorus applied as superphosphate at the rates of 0, 0·33 and 0·66 cwt. of P_2O_5 per acre. Fourteen other experiments were carried out in the four seasons 1952 to 1955. In the majority of these experiments the design was 4 randomized blocks, each of six plots, and addition of fertilizer was as follows: A control (no phosphate): B 0·33, C 0·66, D 1·00, E 2·00, F 4·00 cwt. of P_2O_5 per acre in the form of superphosphate. In two experiments (1955) treatments B and C were with 0·25 and 0·5 cwt. of P_2O_5 respectively.

Procedure

The experiments were carried out on commercial farms and the farmers' normal practice was followed as closely as possible. Farmyard manure was applied at three centres only, in which the soil contained high amounts of easily soluble phosphate. A basal dressing of ammonium sulphate and potassium chloride (usually 5 and 2·5 cwt. per acre respectively) was applied. These materials were mixed with the superphosphate before application by hand in the split drills immediately before planting the potatoes.

The variety of potatoes grown by the farmer was usually accepted for the experimental area as follows: Kerr's Pink (6), Craigs Royal (4), Redskin (2), Arran Consul (2), Epicure (1) and Golden Wonder (1). Visual observations were made on each experiment at intervals during the season.

Harvesting was carried out at the farmer's lifting time as often as possible. The potatoes were dug by hand, bagged and weighed one week afterwards. In the earlier experiments, the total yield only was recorded, but in seven later ones, the crop was riddled through $2\frac{1}{4}$- and $1\frac{1}{4}$-in. riddles and the weights of ware, seed and chats recorded.

In some of the experiments made in 1954 and 1955 detailed measurements were made of haulm height, and weight of haulm, root, and tuber at various stages of growth. These measurements have been reported elsewhere.

Results

The total ' control ' yields of potatoes in tons per acre and the average increase in yield from each dressing of superphosphate are given in Table I. Significant effects are marked by asterisks.

From Table I it is obvious that there was little or no response in the total yield of potatoes to phosphate treatments on soils with available phosphate values greater than 12. In only two of the ' fertile soil ' experiments were there significant increases (5% level) in yield from 0·33 cwt. of P_2O_5 per acre. There were significant responses to 0·66 cwt. of P_2O_5 at two centres.

The crops grown on deficient soils, on the other hand, responded very well. In all four experiments the increase in yield produced by 0·33 cwt. of P_2O_5 per acre was significant at the 1% level, and a further increase in yield was produced by the 0·66 cwt. of P_2O_5 per acre treatment. The average increases in yield on deficient soils due to 0·33 and 0·66 cwt. of P_2O_5 per acre were 3·6 and 5·0 tons per acre respectively.

An interesting point arises from the results for the higher treatments (2·0 and 4·0 cwt. of P_2O_5 per acre). In four of the experiments on fertile soils, the treatment with 4·0 cwt. of P_2O_5 per acre produced a depression in yield compared with the control. In two cases this depression was significant (experiments 6 and 7). In experiment 6 the depressions in yield produced by 1·0 and 2·0 cwt. of P_2O_5 per acre were just significant at the 5% level. In the dry season of 1955,

Table I

The effect of increasing amounts of superphosphate on the yield of potatoes in tons per acre

Year	Centre no.	'Available' P_2O_5, mg./100 g. of soil	Control yield	Increase in yield over control for each treatment				
				Level of dressing of P_2O_5 (cwt./acre)				
			nil	0·33	0·66	1·00	2·00	4·00
1946	1	**5**	3·9	+ 2·2**	+ 3·6**	—	—	—
1948	2	**66**	13·0	— 0·1	— 0·1	—	—	—
1952	3	14	**8·6**	— 0·6	— 0·1	+ 0·7	+ 1·0	+ 0·9
	4	13	16·9	+ 3·1*	— 0·2	+ 0·3	+ 1·5	— 0·5
1953	5	12	14·9	+ 0·	+ 1·4*	+ 0·9	+ 1·4*	+ 0·5
	6	18	16·5	— 0·3	+ 0·2	— 1·0*	— 1·0*	— 1·4*
1954	7	**22**	11·6	0	— 0·3	+ 0·3	0	— 1·4*
	8	**63**	9·7	+ 1·1	+ 0·3	+ 0·7	— 0·3	— 0·8
	9	**56**	**8·9**	+ 0·1	— 0·3	—	—	—
	10	3	3·5	+ 4·0**	+ **6·6****	+ **6·1****	+ **6·1****	+ 7·1**
1955	11	30	**8·8**	+ 1·3	+ 0·2	+ 0·7	+ 0·**6**	+ 0·4
	12	28	10·2	+ 0·5	0	0	+ 0·**6**	+ 0·**8**
	13	24	**10·9**	+ 0·5	0	+ 0·5	0	+ 0·3
	14†	**26**	14·1	+ 3·1*	+ 2·2*	+ 3·2*	+ 1·1	—
	15†	**5**	9·**6**	+ **3·6****	+ 4·7**	+ 5·7**	+ **4·5****	—
	16	5	**8·5**	+ 4·5**	+ 5·3**	—	—	—
Average for nine high-P experiments			**12·0**	+ 0·5	+ 0·2	+ 0·4	+ **0·5**	— 0·1
Average for four low-P experiments			**6·4**	+ 3·**6**	+ **5·0**	—	—	—

† The 0·33 and 0·66 cwt. per acre levels of P_2O_5 were replaced by 0·25 and 0·50 cwt. respectively.
* Significant at 5% level
** Significant at 1% level

the treatment with 4·0 cwt. of P_2O_5 per acre was omitted in experiments 14 and 15, but on *both* the high- and low-phosphate soils a dressing of 2·0 cwt. of P_2O_5 per acre depressed the yield as compared with the treatments with 0·5 and 1·0 cwt. of P_2O_5 per acre. This depression in yield was associated with a definite restriction in root growth in the early part of the season.

In seven of the experiments the crop was riddled over $2\frac{1}{4}$- and $1\frac{1}{4}$-in. riddles and the yield of ware, seed and chats determined. Table II compares the average results for experiments on high- and low-phosphorus soils. The extra profit from fertilizer treatments is also shown. This was calculated by subtracting the cost of fertilizer from the value of the increased quantities of ware, seed and chats, assuming the prices of the three size groups to be £12, £17 and £3 per ton respectively. The cost of superphosphate was assumed to be £2 5*s.* 0*d.* per cwt. of P_2O_5.

Table II

Yield of ware, seed and chats in tons per acre and extra profit from fertilizer treatments

	Rate of dressing of P_2O_5 (cwt./acre)						S.E. ±
	nil	0·33	0·66	1·00	2·00	4·00	
High-P soils							
Ware	5·09	**6·13**	5·**38**	5·**56**	5·0**2**	5·**08**	0·25
Seed	6·75	7·**16**	7·17	7·01	7·41	**6·81**	0·35
Chats	0·35	0·**24**	0·34	0·**38**	0·**44**	0·32	—
Extra profit, £ per acre	—	+ **18·3**	+ **8·9**	+ 7·7	+ 5·7	— 9·2	—
Low-P soils							
Ware	**2·71**	4·71	5·41	5·70	5·07	4·**87**	0·**18**
Seed	3·**63**	5·57	6·**89**	**6·84**	7·43	7·**72**	0·34
Chats	0·**25**	0·33	0·33	0·**29**	0·34	0·**40**	—
Extra profit, £ per acre	—	+ **56·4**	+ **86·4**	+ 88·1	+ 88·2	+ **85·9**	—

In the experiments on soils of high phosphorus status there was very little effect of treatments on the yield of ware. Only 0·33 cwt. of P_2O_5 per acre gave significantly better results than the control. There were no significant differences in seed yield produced by different treatments. The experiments on soils of low phosphorus status present a different picture. For ware, all treatments were significantly superior to control and there was a steady increase in yield

up to the treatment D (1·00 cwt. of P_2O_5 per acre), although the effect of this treatment was not significantly different from that of C (0·50 cwt. of P_2O_5 per acre). The seed yield increased throughout and all treatments gave significantly better results than A. The calculation of extra profit from fertilizer treatment showed the maximum profit from dressings of 0·33 cwt. and 1·00 cwt. of P_2O_5 per acre on high- and low-phosphorus soils respectively.

Discussion

Increases in total yield of potatoes produced by the application of superphosphate were marked on soils with available P_2O_5 values of less than 5 mg. per 100 g. of soil. At three centres with soils with available-P_2O_5 figures of 12, 13 and 26, there was a response to small dressings of phosphate, but in the remaining nine experiments no significant responses were recorded. It appears, therefore, that there is very little likelihood of a response to phosphate treatment if the available soil phosphate (soluble in 0·2N-HCl) exceeds 15 mg. per 100 g. of soil. Further investigation is necessary on soils of all categories to confirm this and to establish the critical level above which no response may be expected. Russell & Garner[3] reported an average response of 0·55 and 0·87 tons per acre, with and without dung respectively, to a dressing of 0·5 cwt. of P_2O_5 per acre for a series of experiments carried out in England and Wales between 1900 and 1941. In their experiments on mineral soils, 18 cases were recorded of non-significant decreases or increases in yield while at 19 centres significant increases in yield were obtained.

Walker[4] working in the West Midland province of England reported average responses of only 0·7 and 0·4 tons of potatoes to a dressing of 2·5 cwt. of superphosphate in 1949 and 1950. In 1949 a dressing of 5 cwt. of superphosphate per acre gave an average yield of 0·6 tons per acre less than the control. In four out of five centres in 1949 the yield from 5 cwt. of superphosphate per acre was less than that from 2·5 cwt.

The response in the yield of ware and seed potatoes to superphosphate on the four phosphate-deficient soils was very marked. The average figures in Table II show an increase of 2·0 and 1·94 tons per acre of ware and seed respectively, for a dressing of only 0·33 cwt. P_2O_5 per acre, with further responses to higher dressings. In the soils with higher amounts of available phosphate, however, the corresponding figures were 1·04 and 0·41 tons per acre and there was no further response to higher rates of superphosphate.

According to Crowther & Yates,[5] the optimal level of fertilization is reached when the value of the increase in crop resulting from a small increment in fertilizer is equal to the costs involved in producing such an increase. The calculation of extra profit from fertilizer applications shown in Table II indicates that the optimal dressing of superphosphate on the high-phosphate soils is not more than 1·65 cwt. per acre, while, on the phosphate-deficient soils, 5·0 cwt. per acre may be applied with profit, although the extra profit produced by increasing the rate of application from 3·3 to 5·0 cwt. is only £1 7*s.* 0*d.* per acre. Church[6] quotes the optimum rate of P_2O_5 for potatoes in England and Wales as 1·4 cwt. per acre or about 9 cwt. of superphosphate. This figure is considerably different from the ones found here, even for deficient soils.

From the lack of response to phosphate fertilizers in the majority of the experiments, it may be deduced that these soils are capable of supplying sufficient available phosphate to meet the needs of the crop, either from natural soil phosphate or from the residues of previous fertilizer applications. Much of the Lothians area has been intensively farmed and well manured for at least 100 years and it may be that a reserve of soil phosphorus has been built up.

It is difficult to say how long this reserve would continue to supply the full crop requirements. If the figures for available soil phosphate are to be taken as a rough guide, a soil with 20 mg. of P_2O_5 per 100 g. of soil contains the equivalent of 20 cwt. per acre of superphosphate in available form. A small fraction of this would supply the requirements of a full crop of potatoes. Many of the soils in the area have available soil phosphate contents greater than 20 mg. of P_2O_5 per 100 g. of soil. A small dressing of superphosphate even on these more fertile soils was found in some cases to give the crop a good start and it is suggested that 1·0 to 2·5 cwt. of superphosphate would perform this function. This is very small compared with the 5 to 9 cwt. commonly applied by farmers. Unfortunately there is, at present, no compound fertilizer on the market which would supply this small amount of superphosphate without reducing

the amounts of nitrogen and potassium applied to a very low level. A suitable constituent ratio for potatoes on such land would be 8 : 3 : 12 or 8 : 4 : 12 applied at the rate of 12 to 13 cwt. per acre. The need for such a 'low-phosphate fertilizer' may be even more marked for crops such as sugar beet or cereals which respond less readily to phosphate than do potatoes.

It is considered that no attempt should be made to build up the phosphate level in the deficient soils. A dressing of 5 6 cwt. of superphosphate per acre should meet the needs of the potato crop on these soils.

Conclusions

The effect of superphosphate on the total yield and yield of ware, seed and chats of potatoes was studied in 16 experiments during 6 seasons. Little or no response in total crop yield was observed on soils with high or moderate available phosphate. On these soils also the yield of ware and seed was unaffected by added phosphate. A compound fertilizer of the type 2 : 1 : 3 would save wastage of superphosphate on such soils.

The optimum level of superphosphate was approximately 5 cwt. per acre for low-phosphate soils and 1·5 cwt. for the soils with higher available phosphate. The latter figure is considerably lower than the present rates of 5–9 cwt. per acre applied by farmers in the area. Several cases of depressions in yield by higher dressings of superphosphate, particularly 10 cwt. per acre, were recorded on high phosphate soils.

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THE AMINO-ACID COMPOSITION OF SOME PAKISTANI PULSES

By N. A. KHAN and B. E. BAKER

A sample of horsebean (*Vicia faba* L.) was analysed for its amino-acid contents, by chromatography on buffered filter paper. The results were in general agreement with those obtained by microbiological assay and already reported in the literature. The coefficients of variation for the determination of different amino-acids ranged from 1·5% to 8·5%.

Eighteen amino-acids have been determined similarly in the whole grains of five species of pulses commonly grown in West Pakistan.

Introduction

The term pulse is generally used to designate certain seeds or plants of the natural order Leguminosae. The pulses are cultivated extensively in India and Pakistan, where the seeds are one of the chief sources of protein for human nutrition. The pulses most commonly cultivated in Pakistan are channa (gram), mung, mash, masur and lobia.

A review of the literature showed that the above mentioned pulses have not been completely analysed for their amino-acid contents and that little or no information is available on the amino-acid composition of the pulses which are cultivated in the North-West Region of West Pakistan.

Lal[1] determined the amino-acids lysine, histidine, arginine, tryptophan and phenylalanine, and Rudra & Chowdhury[2] determined methionine in the whole seeds of gram. Ricceri,[3] who analysed the whole seeds of gram and masur, reported a value for the arginine content of gram which is in fair agreement with that reported by Lal. Sasaki & Okuda[4] determined 16 amino-acids in mash protein prepared by alkali extraction. Their values for methionine are approximately double those given by Rudra & Chowdhury,[2] who expressed their results as percentages of the whole seeds. Belton & Hoover[5] conducted a detailed study of the amino-acid composition of defatted mung seed, while Schweigert[6, 7] conducted a similar study, though in much less detail, on defatted lobia. Several workers have analysed the globulin fractions of pulse proteins.[8–15]

The present investigation was undertaken to determine the amino-acid composition of five pulses commonly grown in the North-West Region of West Pakistan. It was expected that the amino-acid compositions of the pulses might be different from those of the same species grown under different ecological conditions.

Experimental

Materials

The samples used in these experiments were supplied by the Director of Agriculture, North West Frontier Province, West Pakistan. The seeds were ground in a Mikro-Samplemill using a screen with openings of 1 mm. diameter and the ground material was stored in tightly stoppered bottles. Table I shows the results of proximate analyses by standard methods (A.O.A.C.) of the ground pulses.

Table I

Proximate analyses of five Pakistani pulses

Pulse	Moisture %	Crude protein (N × 6·25) %	Ether extract %	Ash %	Crude fibre %	Nitrogen-free extract %
Channa (Gram) (*Cicer arietinum*)	8·6	17	4·0	4·4	9·5	56
Lobia (*Vigna sinensis*)	8·1	23	2·0	3·3	4·2	59
Masur (*Lens esculenta*)	9·8	22	1·3	3·2	3·8	60
Mung (*Phaseolus mungo*)	9·1	24	1·9	4·0	3·6	57
Mash (*Phaseolus radiatus*)	6·7	22	2·0	3·5	3·9	62

Method

The buffered filter paper chromatographic method developed in this laboratory was employed for the determination of eighteen amino-acids.[16] For all determinations, except that of tryptophan, samples (250 mg.) were autoclaved for 12 hours in sealed tubes with 6N-hydrochloric acid (5 ml.). Alkaline hydrolysis was accomplished by autoclaving the sample (250 mg.) for 24 hours, with 1·4 g. of recrystallized barium hydroxide dissolved in 10 ml. of water. The hydrolysate solutions were prepared for analysis by the method described previously.[16]

Before the analysis of the pulses, the method was employed for the analysis of a sample of horsebean, which had been analysed previously in this laboratory by the microbiological method.[17]

Table II shows the results of the analysis of duplicate hydrolysates. Each result represents

the average of eight actual determinations. It will be noted that, except in the analysis of serine, somewhat higher results were obtained by the chromatographic method than by the microbiological method.

Table II

Comparison of amino-acid assay values on horsebean

Amino-acid	Amino-acids of horsebean (3·95% N), g./100 g. Series 1	Series 2	Microbiological method*** (reference 17)
Alanine	0·978 (0·029*, 3·0**)	0·965 (0·037*, 3·8**)	0·652
Arginine	1·83 (0·072, 3·9)	1·86 (0·050, 2·7)	1·54
Aspartic acid	2·22 (0·036, 1·6)	2·27 (0·047, 2·1)	1·47
Glutamic acid	3·74 (0·13, 3·5)	3·65 (0·095, 2·6)	3·38
Glycine	0·967 (0·020, 2·1)	0·946 (0·014, 1·5)	0·920
Histidine	0·810 (0·035, 4·3)	0·800 (0·030, 4·3)	0·715
*iso*Leucine	1·46 (0·095, 6·5)	1·58 (0·054, 3·4)	1·37
Leucine	2·55 (0·093, 3·6)	2·53 (0·082, 3·2)	1·88
Lysine	1·62 (0·036, 2·2)	1·68 (0·049, 2·9)	1·37
Methionine	0·159 (0·0059, 3·7)	0·152 (0·0046, 3·0)	0·134
Phenylalanine	1·30 (0·020, 1·5)	1·35 (0·029, 2·1)	0·850
Proline	1·18 (0·10, 8·5)	1·02 (0·039, 3·8)	1·12
Serine	0·982 (0·022, 2·2)	0·990 (0·015, 1·5)	1·41
Threonine	1·09 (0·027, 2·5)	1·09 (0·024, 2·2)	0·652
Tryptophan	0·257 (0·013, 5·1)	0·244 (0·0087, 3·6)	0·223
Tryosine	1·06 (0·046, 4·3)	1·11 (0·043, 3·9)	0·760
Valine	1·36 (0·034, 2·5)	1·35 (0·024, 1·8)	1·27

* Standard error
** Coefficient of variation
*** Calculated to 3·95% nitrogen

Results

The five Pakistani pulses listed in Table I were analysed for their amino-acid composition by the method outlined above. The results of the analysis of duplicate hydrolysates, of each pulse, are reported in Series 1 and Series 2 of Table III. Each result, as in the analysis of horsebean, represents the average of eight actual determinations. Table IV shows the result for the analysis of the pulses, calculated as a percentage of the crude protein (N × 6·25). The data were calculated from the averages of the results given in Table III.

Table III

The amino-acid composition of five Pakistani pulses

Amino-acid	Amino-acid of whole seed, g./100 g. Channa (2·75% N)		Lobia (3·67% N)		Masur (3·45% N)		Mung (3·88% N)		Mash (3·53% N)	
	Series 1	Series 2	Series 1	Series 2	Series 1	Series 2	Series 1	Series 2	Series 1	Series 2
Alanine	0·804	0·833	0·978	0·929	1·08	0·997	0·921	0·939	0·885	0·938
Arginine	1·28	1·22	1·64	1·58	1·79	1·85	1·29	1·20	1·00	0·954
Aspartic acid	2·20	2·13	2·71	2·69	2·89	2·78	2·68	2·62	2·73	2·62
Glutamic acid	3·35	3·28	3·78	3·69	3·79	3·82	4·08	3·94	3·82	3·67
Glycine	0·653	0·685	0·866	0·906	0·799	0·883	0·866	0·879	0·871	0·907
Histidine	0·773	0·761	0·776	0·754	0·813	0·831	0·780	0·815	0·906	0·878
*iso*Leucine	1·39	1·33	1·44	1·41	1·30	1·41	1·41	1·42	1·51	1·54
Leucine	2·49	2·37	2·65	2·50	2·32	2·35	2·56	2·55	2·81	2·88
Lysine	1·67	1·76	1·50	1·50	1·71	1·72	1·59	1·70	1·79	1·79
Methionine	0·178	0·182	0·194	0·199	0·145	0·154	0·267	0·275	0·184	0·187
Phenylalanine	1·37	1·39	1·38	1·36	1·37	1·32	1·49	1·57	1·51	1·60
Proline	0·913	0·903	1·11	1·11	1·16	1·15	0·955	0·995	1·05	1·02
Serine	0·936	0·952	1·15	1·12	1·06	1·10	1·02	1·00	1·21	1·14
Threonine	0·913	0·794	1·27	1·16	0·983	0·944	0·954	0·917	0·997	0·982
Tryptophan	0·296	0·318	0·299	0·294	0·257	0·268	0·336	0·344	0·298	0·297
Tyrosine	0·820	0·805	0·649	0·642	0·516	0·544	0·674	0·622	0·842	0·856
Valine	0·833	0·839	1·12	1·12	1·18	1·16	1·33	1·37	1·37	1·36

Table IV

*Comparison of the amino-acid composition of pulse proteins**

Calculated as % of the crude protein (N × 6·25)

Amino-acid	Channa %	Lobia %	Masur %	Mung %	Mash %
Alanine	4·77	4·16	4·82	3·84	4·15
Arginine	7·27	7·00	8·45	5·15	4·44
Aspartic acid	12·6	11·8	13·2	10·9	12·1
Glutamic acid	19·3	16·3	17·6	16·5	17·0
Glycine	3·88	3·86	3·85	3·60	4·03
Histidine	4·46	3·33	3·81	3·28	4·05
*iso*Leucine	7·90	6·24	6·30	5·80	6·95
Leucine	14·1	11·3	10·9	10·5	12·9
Lysine	10·0	6·54	7·96	6·80	7·94
Methionine	1·05	0·858	0·695	1·12	0·845
Phenylalanine	8·03	5·96	6·25	6·30	7·07
Proline	5·31	4·83	5·37	4·02	4·72
Serine	5·50	4·97	5·00	4·16	5·35
Threonine	4·96	5·31	4·47	3·85	4·50
Tryptophan	1·78	1·28	1·22	1·40	1·35
Tyrosine	4·74	2·82	2·46	2·67	3·86
Valine	4·86	4·88	5·42	5·57	6·23

* Data based on the results obtained by taking the average of the values for each amino-acid in each series

Discussion

A comparison of the results now reported for horsebean, with the results secured previously by microbiological assay, shows that the two methods gave results in reasonable agreement. It was evident from the duplicate analyses that the results obtained by the chromatographic method were reproducible. The standard errors ranged from 0·0046 for methionine (0·152%) to 0·13 for glutamic acid (3·74%). The coefficients of variation ranged from 1·5% for glycine (0·946%), phenylalanine (1·30%) and serine (0·99%) to 8·5% for proline (1·18%).

It is of interest to compare the results obtained by the chromatographic method with results reported in the literature, although it is realized that the observed differences may be due to variation in the amino-acid composition of different species and varieties of pulses grown under different ecological conditions, as well as to purely technical factors.

Lal[1] reported values for the lysine and histidine contents of gram which are somewhat higher, and values for phenylalanine, arginine and tryptophan which are a little lower than those obtained by the chromatographic analysis of the Pakistani sample. Rudra & Chowdhury's results for methionine, and Ricceri's result for arginine were both higher than the values obtained in this laboratory. The results for the amino-acid composition of mung are in fair agreement with the results obtained by Massieu *et al.*,[18] who analysed *Phaseolus vulgaris*. Outstanding differences are observed between the amino-acid composition of *Phaseolus mungo* and the composition of *Phaseolus aureus* Roxburgh.[5] Fairly close agreement is observed between the amino-acid composition of cow pea (lobia) reported by Schweigert[6, 7] and the composition of the sample of this pulse analysed in this laboratory.

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SURFACE PROPERTIES OF PHOSPHATE MATERIALS BY ISOTOPIC EXCHANGE. I.—Rock Phosphate

By J. CANO RUIZ* and O. TALIBUDEEN

Radioactive phosphorus is used in the estimation of the surface phosphate of apatite rock. Surface areas of these materials calculated from these estimates are smaller than those derived from gas-adsorption methods. Less than 2·5% of the total phosphorus exists as surface phosphorus in the 100-mesh size fraction of these materials.

Introduction

The particle-size of fertilizers, in particular of sparingly soluble materials, is of considerable interest in studies of plant-nutrient uptake and in making superphosphate from rock phosphates. Measurements of surface area, which are necessary to assess particle size beyond the range of conventional sieve analysis, give information on the porosity of these materials by providing the sum of the internal and external surface areas. Thus steamed bone has a total surface area five times that of enamel, dentine or commercially chipped bone ; whilst enamel, dentine and ' hard ' and soft rock phosphates have surface areas far in excess of their particle boundary surfaces as calculated from particle size measurements.[1]

Isotopic exchange methods with radio-phosphorus have been used to determine the total surface area of bone and allied materials,[2] rock phosphates,[3] and synthetic calcium phosphates[3, 5] in suspension, by a variety of methods. Gas adsorption methods with nitrogen at liquid-nitrogen temperatures have also been used for the same purpose.[1]

The purpose of this paper is to present preliminary data on surface areas determined by tracer methods, to compare them with values obtained by gas adsorption, and to compare the values obtained by different workers whenever possible.

Theory

The theoretical basis of the experimental procedure and the analysis of the results have been fully discussed elsewhere.[4] To summarize, the (f_t,t) curve, where f_t is the fractional activity left in solution after time t, due to isotopic exchange between solution and solid in chemical equilibrium, is made up of rapid and slow exchange processes. Extrapolation of the slow-exchange portion of this curve to $t = 0$ permits the evaluation of the fractional activity in solution due to isotopic exchange by the rapid process which is assumed to govern the exchange between surface ions and ions in solution. From the values of f_t due to the rapid-exchange process and the phosphorus measured in solution, the isotopically exchangeable phosphorus

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(P_e) corresponding to the 'surface' phosphorus can be calculated from the relation

$$(P_e)_t = \frac{P_{solution}}{f_t}$$

Expressed per unit weight, this measures the surface phosphate area of the solid which can be converted into conventional units of area (sq. m. per g.) from the average area, 20 Å^2 approximately, of an orthophosphate group pictured as a cube, taking the density of fluorapatite as 3·2.

Using Olsen's approximate extrapolation procedure[5] (see Discussion) it is also possible to calculate approximately the labile P at isotopic equilibrium, which can be similarly converted to sq. m. per g.

Experimental

A 1-g. sample of the mineral was shaken with 500 ml. of 0·001M half-neutralized phenylbarbituric acid (pK = 7·95) until there was no further increase in the phosphorus content of the solution. (The time required for this equilibrium was about 12 hours.) After shaking for 20–24 hours, the solution was tagged with 2μc of carrier-free radioactive P. The system was kept in continuous agitation and the decrease in radioactivity of the solution measured at various times. At the end of each run the solution was analysed for final ^{32}P and P contents and pH after filtration of the suspensions through sintered glass crucibles (porosity 4). A modification of the Truog & Meyer method was used to measure the P content. The standard deviation of the counting procedure for radioactivity determinations was 1%. The variation in pH of the barbiturate buffer over the course of each experiment was not above 0·1 unit. The filtration is not very reproducible unless extreme analytical control and great care is exercised, and is also too slow for sampling in rate experiments, which reduces the accuracy with which the concentration of radioactivity can be determined in the solution.

The minerals were analysed for total P by digestion of 100 mg. of mineral in 10 ml. of concentrated HCl and 1 ml. of 60% $HClO_4$. P content was estimated colorimetrically by the vanadomolybdate method.[6]

Results and discussion

Analytical data of the minerals used are presented in Table I.

Table I

Chemical analyses of samples of rock phosphate

Rock phosphate	Total P, %	Fluoride as F, %	Carbonate as CO_2, %	Other impurities %
Kola concentrate	15·85	2·61	0	14·1
Haliburton fluorapatite (Ontario, Canada)	16·80	(3·43)	0	8·90
Sukulu concentrate (Uganda)	17·05	——	——	7·6
Nauru	15·64	2·40	2·04	10·5
Morocco	14·57	4·31	4·12	9·0
Curaçao	15·02	0·38	2·73	12·3
Florida Hard Rock	13·85	3·88	2·92	16·1
Fluorapatite (theoretical)	18·45	3·77	——	——
Hydroxyapatite (theoretical)	18·50	——	——	——

It will be seen that fluoride contents vary from nil (hydroxyapatite) to more than 10% above the theoretical amount for fluorapatite, whilst the carbonate content varies from nil to 41 mg. per g. The P content is assumed truly to express the amount of hydroxy- or fluorapatite present and the extent of impurities, other than $CaCO_3$ and excess CaF_2 calculated by difference, are given in the last column.

Data from the isotopic-exchange experiments are given in Table II. Generally an increased equilibrium P concentration in barbital solution is a reflection of the smaller carbonate content of the mineral, due presumably to a decrease in the calcium ion concentration of the solution at constant pH. The fluorine content does not seem to be significant, as Curaçao phosphate, with only 10% of the theoretical fluorine content for fluorapatite, has a lower P concentration than Nauru or Kola phosphate.

Table II

Results of isotopic exchange experiments

Rock phosphate	Concn. of P in the 0·001M-barbitone solution	Equilibrium pH	Labile P in mg. per g. of rock				
			P_e 24 h.	P_e 48 h.	P_e 72 h.	P_e Surface	P_e (after Olsen)
Kola	$2{\cdot}64 \times 10^{-5}$M	7·5	0·633	0·668	0·674	0·631	0·75
Ontario	$1{\cdot}11 \times 10^{-5}$M	7·6	0·582	0·650	0·720	0·548	0·96
Sukulu	$1{\cdot}16 \times 10^{-5}$M	7·6	0·507	0·534	0·545	0·514	0·61
Nauru	$2{\cdot}10 \times 10^{-5}$M	7·5	—	—	4·16	3·82*	—
Morocco	$3{\cdot}88 \times 10^{-6}$M	7·7	1·67	2·00	2·45	1·33	4·4
Curaçao	$5{\cdot}17 \times 10^{-6}$M	7·6	0·494	0·533	0·545	0·491	0·63
Florida	$8{\cdot}07 \times 10^{-6}$M	7·6	0·664	0·691	0·699	0·658	0·75

* Extrapolated from Rickson's data[3]

P_e-values show that isotopic equilibrium is nearly complete, within the limits of experimental error, in 48 hours for all minerals for which exchange curves were obtained, except the Ontario and Morocco rock phosphates. The extrapolation of these values to $t = 0$ gives 'surface P_e' values in mg. of P per g. of sample, given in the penultimate column. The last column gives the exchangeable P value at 'isotopic equilibrium' after Olsen.[5] These are converted into conventional units of surface area by assuming that the PO_4''' ion occupies a surface area of 20 Å^2. This approximate figure can be obtained in two ways; from the unit cell dimensions of the apatite lattice and from molecular volume of apatite using a density value of 3·2.

In Table III, these results are compared with the values calculated from the results of similar experiments by other workers[1, 3, 5] and with surface areas measured by nitrogen adsorption.[1] These are corrected approximately to the 100-mesh sieve size from the data given by Hill *et al.*[1]

It is clear from such a comparison that the results from isotopic exchange measurements are much lower than those by nitrogen adsorption. This may be due to (*a*) a lack of standardization of the samples, (*b*) the absence of an out-gassing procedure in the isotopic exchange method, customary in gas-adsorption work, to clear the pores of air-locks in the solid, or (*c*) underestimation of the surface phosphate by the extrapolation procedure used above. The authors consider that the extrapolation procedure takes into account only the external surfaces and the surfaces in the larger pores and does not differentiate between isotopic exchange due to the surfaces of finer pores and that due to diffusion of PO_4''' ions into the solid matrix. Future work is to be directed towards the application of Langer's test[7] to permit such differentiation. However, in three samples (Morocco, Curaçao and Florida) where comparison is possible, the difference in porosity between samples is reflected by both methods (Table III, columns 2 and 5) although it is not proportionate.

Table III

Surface area values of rock phosphates, sq. m./g.

Rock phosphate	This method		Rickson[3]	Nitrogen adsorption (Hill[1])
	Rapid exchange	(after Olsen)		
Kola	2·46	2·9	—	—
Ontario	2·1	3·7	—	—
Sukulu	2·0	2·4	—	—
Nauru	14·9	—	1·14	—
Morocco	5·2	17·3	4·0*	13·5
Curaçao	1·91	2·5	0·44	6·4
Florida	2·56	2·9	0·84	11·2

1 mg. of labile P per g. of rock = 3·9 m.^{2} per g. of rock (area of PO_4''' group 20 Å^2)

* in 0·1M-$(NH_4)_2SO_4$ solution

Rickson's figures are consistently much lower than the results of these measurements, except that on Morocco Rock which was measured by Rickson in 0·1M-$(NH_4)_2SO_4$. It is difficult to discuss this point in detail because of the lack of pH control in Rickson's experiments. Previous work on bone and synthetic apatite systems has shown that when apatites are suspended in

unbuffered systems, the Ca/P ratio of the solid slowly increases whereas the pH of the solution falls. This occurs even though the PO_4''' concentration in solution may change continuously. There is considerable evidence in the literature that freshly precipitated phosphatic and other compounds have a much larger surface area than the corresponding 'aged' precipitates. However, no comparison is attempted here with freshly precipitated material, because, in the authors' opinion, self-diffusion of PO_4''' ions by recrystallization obscures self-diffusion by true 'surface-exchange'. This gives abnormally high 'surface-exchange' values for freshly precipitated materials.

When apatites, especially those containing carbonaceous impurities, are shaken with phosphate solutions, PO_4''' ions are removed from solution either by adsorption or by precipitation of basic phosphates. It would appear that isotopic exchange under such conditions would give an erronous estimate of the surface phosphate area. Indeed, experiments with Rothamsted soils show that the estimated labile phosphate progressively decreases in the presence of larger phosphate concentrations.[8] However, Olsen[5] has shown for one apatite that the surface phosphate value remains unchanged over a 200-fold increase in P concentration provided this value is calculated from the radioactivity in solution at isotopic equilibrium. This equilibrium value is obtained by extrapolation of the slow-exchange rate to infinite time. From the results of his first experiment, it is difficult to justify such an extrapolation, although by combining his surface phosphate value with the surface area of the apatite from gas-adsorption methods, the surface area of PO_4''' group works out to be almost the same as the value calculated from density and *X*-ray data. Olsen's second method follows the principles derived from Langer's work applied earlier to work on soils[9] in which the time required to determine complete surface exchange is progressively reduced as the amount of exchanging solid is reduced. This method gives a figure of 3·23 mg. for the surface phosphate of 1 g. of 200-mesh Florida Rock. Corrected approximately to 100-mesh size, this gives a figure 10 sq. m. per g. which compares very favourably with the gas-adsorption value (Table III).

Finally, from Tables I and II, it would appear that the rapidly exchangeable 'surface' phosphorus, expressed as a percentage of the total phosphorus, varies from 0·30% in Sukulu Rock to 2·4% in Nauru Rock.

Conclusions

Three types of isotopic exchange methods have been used to estimate the surface phosphate of apatites. Their results are compared with gas-adsorption data by using the area of a PO_4''' group from known density and *X*-ray data. Rickson's procedure[3] in aqueous unbuffered suspensions gives very low results. Olsen's first method,[5] using phosphate solutions of various concentrations with one apatite sample, gives normal results by a rather dubious extrapolation procedure. The method used in this work gives moderately low results although they follow the order suggested by gas adsorption methods. Olsen's second method,[5] employing small amounts of solids at high dilution, appears to give satisfactory results without requiring the extrapolation of results. In future work in this laboratory, it is intended to use a modification of this method to determine the surface area of apatites and allied materials.

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JOURNAL OF THE SCIENCE OF FOOD AND AGRICULTURE

ABSTRACTS

MAY, 1957

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

INDEX OF AUTHORS' NAMES

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JOURNAL OF THE SCIENCE OF FOOD AND AGRICULTURE

ABSTRACTS

MAY, 1957

I.—AGRICULTURE AND HORTICULTURE

General : Soils and Fertilizers

Cultural and chemical aspects of crop production : soil problems in the field. N. H. Pizer (*Chem. & Ind.*, 1956, 1170).—A review of East Anglian soil types and conditions, soil structures, problems of soil acidity, etc. J. S. C.

Chemical properties of southern Ontario soils. K. N. Jeyaseelan and B. C. Matthews (*Canad. J. agric. Sci.*, 1956, **36,** 394—400).—Mechanical and chemical data for 643 soils in 57 soil series are considered. Variation in physical and chemical properties were greater between soil series than within a single series and greater between than within the great soil groups. Surface soil texture was closely correlated with chemical characteristics and particle size distribution and may be regarded as an important criterion in soil classification. A. G. POLLARD.

Salt land survey in Western Australia, 1955. G. H. Burvill (*J. Agric. W. Aust.*, 1956, **5,** 113—119).—The problem of salt-affected land is discussed. A. H. CORNFIELD.

Soil conservation in Western Australia, 1946—56. G. H. Burvill (*J. Agric. W. Aust.*, 1956, **5,** 193—198).—A general account. A. H. CORNFIELD.

Chemicals for soil conditioning. J. P. Martin, J. L. Mortensen, G. S. Taylor and W. P. Martin (*J. agric. Food Chem.*, 1956, **4,** 842—847).—A review of the use of soil conditioners and their effect on the physical properties of soils and on plant growth. N. M. WALLER.

Effect of soil conditioners on crops and soils. R. M. Holmes (*Dissert. Abstr.*, 1956, **16,** 1307—1308).—A variety of soil conditioners was evaluated in divers ways. The effect of soil micro-organisms on conditioners was studied in agar and silica gel. Conditioners having a long chain length and a cation imparting hydrophobicity were the most effective. Those containing Na or a similarly-acting cation upset the cation balance in soils and cause unfavourable growth conditions. Conditioners which are slightly hydrophobic have the greatest longevity, and allow better utilization of water reserves during drought. Conditioners which stabilize soil aggregates are anti-crustants. G. HELMS.

Effect of some synthetic polymeric compounds on soil aggregate stability and on yield and composition of plants. R. E. Warnock (*Dissert. Abstr.*, 1956, **16,** 1195).—Conditioner solutions (0·5%), sprayed on the surface of a well-prepared seed bed reduced crust formation and aided seedling emergence ; 0·1% solution applied to the surface 6 in. of soil increased yields of vegetable crops in some cases. Plant composition was unaffected. In general conditioners containing Na increased the Na content of plants, decreased appreciably the K and slightly reduced the Ca and Mg contents. The duration of increased stability of soil aggregates is discussed. O. M. WHITTON.

Altitudinal and microclimatic relationship of soil temperature under natural vegetation. R. E. Shanks (*Ecology*, 1956, **37,** 1—7).—Soil temp. at a depth of 6 in. in the Grey Smoky mountains depended on the type of vegetation cover (beech and spruce, deciduous trees and hemlock). The temp. differences recorded were sometimes as great as would be caused by an altitude difference of 2000 ft. L. G. G. WARNE.

Yearly soil temperature in Eastern North Dakota. L. D. Potter (*Ecology*, 1956, **37,** 62—70).—Soil temp. were recorded at 1 and 6 in. and 1, 2, 3, 4, 5 and 6 ft. under different crops. The greatest lag in heat penetration and loss was in soil carrying a maize crop, max. and min. temp. at 6 ft. being reached 1½ to 2 months later than in ploughed fields, wheat mulch or grass sod. After winter freezing, thawing occurred from both above and below and the frost-free period was longest under grass. Snow cover caused soil surface thawing and a higher soil temp. In spring and autumn the soil temp. was uniform throughout the depth tested. L. G. G. WARNE.

Overhead spray irrigation. G. Turck (*Rhod. agric. J.*, 1956, **53,** 182—204).—Requirements of and factors affecting overhead spray irrigation are presented and discussed. A. H. CORNFIELD.

Surface reactions of clay minerals. M. M. Mortland and A. E. Erickson (*Proc. Soil Sci. Soc. Amer.*, 1956, **20,** 476—479).—Ethylene glycol retention of non-expanding lattice clays was similar whether Ca, Mg or K was the saturating cation. With expanding lattice clays ethylene glycol retention decreased in the order Ca-, Mg-, K-clay. Limited grinding of the clays increased both cation-exchange capacity and ethylene glycol retention of non-expanding lattice clays, but increased only the cation-exchange capacity of expanding lattice clays. Sp. surface calculated from ethylene glycol retention values and B.E.T. NH_3 adsorption values gave similar results with non-expanding lattice clays, but those calculated from ethylene glycol retention were the greater for expanding lattice clays. A. H. CORNFIELD.

Alteration of biotite to vermiculite by plant growth. M. M. Mortland, K. Lawton and G. Uehara (*Soil Sci.*, 1956, **82,** 477—481).—Biotite crystals were ground to pass 60 mesh and mixed with quartz. Four successive crops of wheat were grown on the mixture which was supplied with all nutrients except K. At the end of the growing period the biotite was shown by *X*-ray diffraction, K content, cation-exchange capacity and ethylene glycol retention, to have been changed to vermiculite. T. G. MORRIS.

Exchangeable cation characteristics of some west-central Alberta soils. S. Pawluk and C. F. Bentley (*Canad. J. agric. Sci.*, 1956, **36,** 380—389).—An examination of a series of soils formed from similar parent material and ranging from black earths through varying stages of podzolic degradation to podzolized grey-wooded soils. Relationships between leaching intensity and weathering are traced. The amount and nature of vegetation is a factor in the formation of this soil series. A. G. POLLARD.

Influence of plant roots on soil reaction. W. Seiberth (*Z. PflErnähr. Düng.*, 1956, **75,** 244—257).—pH determinations were carried out at four-weekly intervals on 6 soils involving three different manuring methods with potatoes as the crop. No direct root influence is to be observed, although variations over the year are caused by manuring, cultivation, water, etc. M. LONG.

Investigations of P in loess and S. Bavarian soil profiles. F. Kohl *Z. PflErnähr. Düng.*, 1956, **75,** 114—131).—The P status of profiles of 26 soils is investigated. The comparison of lactate-sol. P with total P (aqua regia extract) allows conclusions to be drawn. The development and formation of soil type stand in close relationship to the P content of the profile. The P content is related to the composition of the original rock. Hill soils require special attention with regard to sampling. M. LONG.

Determination of available phosphorus in tropical soils by extraction with sodium hydroxide. D. H. Saunder (*Soil Sci.*, 1956, **82,** 457—463).—Determinations of available P by conventional methods are unsatisfactory in tropical red soils. Hot 0·1N-NaOH has been found to give better results. After a pretreatment with N-NaCl in 0·1N-HCl to remove $Ca^{\cdot\cdot}$ and CO_3'' the soil is treated with 0·1N-NaOH and the P estimated in the extract. Data are given correlating NaOH availability of P and crop yields for a variety of crops and Rhodesian soils. T. G. MORRIS.

Extraction of soils with HNO_3–$HClO_4$ for the determination of total phosphorus using the vanadate-molybdate method. W. Wenzel (*Z. PflErnähr. Düng.*, 1956, **75,** 216—222).—Comparison is made by Hissink's solution, aqua regia and HNO_3–$HClO_4$ for extracting total P from soils, together with variations of technique in the actual colorimetric determination. The advantages of $HNO_3/HClO_4$ are : incomplete oxidation of org. matter is avoided, pptn. of SiO_2 is not necessary and P can be determined gravimetrically or colorimetrically since the solution is colourless. The procedure is shorter than the others and fewer steps are involved. M. LONG.

Sulphur and plant nutrition in New South Wales. J. T. Moraghan and R. G. Weir (*Agric. Gaz. N.S.W.*, 1956, **67,** 176—179).—A general account. S is deficient in the Tablelands (basalt-derived soils) and possibly other areas. S deficiency is usually, but not always, associated with P deficiency. A. H. CORNFIELD.

Determination of free iron oxide in soils. A. D. Haldane (*Soil Sci.*, 1956, **82,** 483—489).—The determination of Fe_2O_3 in soils has been examined. A technique is described in which the soil is dispersed in NaOH, the Fe dissolved in oxalate buffer and finally determined volumetrically with dichromate. Fe_2O_3 particles $<20\mu$. diameter are completely dissolved in 1 hour. Most other minerals are unaffected by the treatment. T. G. MORRIS.

Determination of Fe in soil extracts with titanium trichloride. S. Spauszus (*Z. PflErnähr. Düng.*, 1956, **75,** 162—164).—The determination of Fe is described as well as an apparatus to maintain the titanium trichloride solution in a CO_2 atm. The method is rapid,

consisting only of a titration. It compares favourably in accuracy with the permanganametric-$SnCl_2$ reduction technique.
M. LONG.

Soil and plant manganese studies with soya-beans. I. Chemical estimation of available soil manganese. II. Methods and materials for correcting manganese deficiency. D. J. Hoff (*Dissert. Abstr.*, 1956, **16**, 1310—1311).—I. The relationship between Mn absorption by soya-bean plants and Mn extractable from soil by chemicals was studied. For determining available Mn in soil, extraction with $NH_4H_2PO_4$ was superior to that with H_2SO_4,HNO_3, quinol in NH_4 acetate, and Na acetate, or to determination of exchangeable Mn; extraction with H_3PO_4 and alcoholic quinol gave results similar to that with $NH_4H_2PO_4$.

II. Under field and greenhouse conditions, Mn deficiency was corrected by applying $MnSO_4$ to the soil; Mn in fritted form was less effective and its availability was not increased by joint use of fertilizer. Foliar-application of aq. $MnSO_4$ increased the Mn content of soya-bean plants 30—40-fold in the first hour during which time 10—15% of the applied Mn was absorbed. G. HELMS.

Nutrient supplied to the ground in road dust. C. O. Tomm and T. Troedsson (*Oikos*, 1955, **6**, 61—70).—In Sweden, dust blown from an untarred road was collected from the surface of the snow cover of the adjacent ground. At 5 metres from the road the dust contained Ca 1·2—1·8, K 0·07—0·15 and Na 0·07—0·21 mg. per sq. dm. of surface, the values at 150 metres falling to 0·07, 0·04 or less and 0·06 or less respectively. L. G. G. WARNE.

Influence of humus content and humic compounds on the water capacity of soils. H. Linser and W. Pelikan (*Bodenkultur*, 1956, **9**, 16—26).—Micro-water-capacity determinations (method previously described, *Bodenkultur*, 1950, **4**, 352—356) on various soils show a linear dependence on the humus content of the soil. Chalk content has no effect. "Humonstaub" additions to loess soils poor in humus also give rise to linear responses of water capacity, whilst humic acid additions give rise to an asymptotic response. Root residue decomposition is shown by micro-water-capacity figures.
M. LONG.

Humus content of meadows. F. Zürn (*Bodenkultur*, 1956, **9**, 27—42).—Soils under permanent pasture have higher humus contents than those under temporary leys which in turn have higher contents than arable soils. Mineral fertilizers increase the humus content of soils under pasture, org. fertilizers not being necessary and not supplying sufficient nutrients. The manuring of arable land can be carried out satisfactorily with mineral fertilizers, although org. matter may be necessary in exceptional cases. M. LONG.

Occurrence of indole compounds in "black earth" humic acids.—Preliminary communication. W. Flaig and T. Breyhan (*Z. PflErnähr. Düng.*, 1956, **75**, 132—135).—The residue left from 6N-HCl hydrolysis of humic acids from "black earths" contains N. About 50% of this can be removed by alkali fusion as NH_3. Chromatographic evidence shows the rest to be mainly, if not completely, of the nature of indole. M. LONG.

Stability of soil humus and its components under natural conditions. W. Wittich and L. Mainzhausen (*Z. PflErnähr. Düng.*, 1956, **75**, 228—243).—The disappearance of soil humus and the effect on its stability of the removal of forest litter is investigated. With time, the rate of disappearance decreases due to the remaining humus being more resistant. This fraction is also of higher N content. Likewise sol., amino- and hydrolysable (6N-HCl) N disappear more quickly than non-hydrolysable N. In regions where N disappears rapidly, the resistant humus absorbs NH_3 ions, and also gives rise to fresh sol. N. Humus, not extracted by dil. alkali, also increases relatively when litter is removed. G-humic acids are more stable than B-humic acids and have a higher ash content, especially with regard to silicates. The impurities removed in purifying humic acids appear more stable than the pure humic acids.
M. LONG.

Distribution of amino-acids in selected horizons of soil profiles. F. J. Sowden (*Soil Sci.*, 1956, **82**, 491—496).—The amino-acid content of the A and B horizons of 5 soils were examined chromatographically. Up to 40% of the total N present was found in the form of 14 amino-acids. The amounts of amino-acids present were similar in nearly all soils. T. G. MORRIS.

Detection of free amino-acids in soil. T. M. B. Payne, J. W. Rouatt and H. Katznelson (*Soil Sci.*, 1956, **82**, 521—524).—Results reported show that free amino-acids can be detected by chromatography in aq. soil extracts that have been concentrated by freeze-drying. Concentration at 40° in a vac. destroys almost all of the acids. Air drying the soil before leaching increases the free amino-acid content.
T. G. MORRIS.

Preliminary survey of fungi in some Sudan soils. M. A. Nour (*Trans. Brit. mycol. Soc.*, 1956, **39**, 357—360).—Three different methods were used and ten soils tested. All methods and soils gave similar results with *Rhizopus stolonifer*, *Aspergillus nidulans*, *A. niger*, *A. flavus*, *Curvularia lunata*, *Alternaria tenuis* and *Fusarium solani*, the commonest fungi. L. G. G. WARNE.

Effect of substrate on a microbial antagonism with reference to soil conditions. D. Park (*Trans. Brit. mycol. Soc.*, 1956, **39**, 239—259).—*Bacillus macerans* isolated from partially sterilized soil was grown in agar with *Fusarium roseum*. At first there was a mutual inhibition of growth, but both on agar and in liquid cultures the fungus eventually became dominant. In autoclaved soil the fungus at first grew and produced conidia but then lysis of the fungal structures occurred. L. G. G. WARNE.

Denitrification in soil. H. Nõmmik (*Acta agric. scand.*, 1956, **6**, 195—228).—Rates of denitrification varied with soil type, structure, pH, org. matter content, temp. and water content. The last-named factor was of major importance. No denitrification occurred with water contents <60—70% of the water-holding capacity. Experimental data support the view that N_2O is the obligatory precursor of N_2 in the reduction process. NH_3 occurs only in small amounts. NO is a product of the reduction of NO_2' but not of NO_3'.
A. G. POLLARD.

Nitrogen-fixing activity of some soil actinomycetes. M. V. Fedorov and T. K. Kudryasheva (*Dokl. Akad. Nauk. SSSR*, 1956, **108**, 345—348).—Fixation of up to 10 mg. of atm. N_2 per g. of glucose metabolized was observed in 30-day cultures of *Actinomycetes* species in N-free medium at 30°. R. TRUSCOE.

Growth of root micro-organisms in direct contact with superphosphate granules. K. P. Tulaïkova (*Mikrobiologiya*, 1956, **25**, 299—304).—Growth of azotobacter, radiobacter, and ammonifying, denitrifying and aërobic cellulose-fermenting bacteria was depressed within a zone around granules of superphosphates placed on agar plates, but stimulated outside this zone; no stimulating effect was found for actinomyces and fungi. The H_3PO_4 diffusing out of the granules into the depression zone is neutralized, and the zone is invaded, by ammonifying bacteria after three days of incubation, and fully overgrown within 10 days; denitrifying organisms do not enter this zone during 25 days of culture, although they contribute to the lowering of acidity within it. R. TRUSCOE.

Effect on soil microbiological processes of mixed organic–mineral fertilizers. P. A. Vlasyuk, K. M. Dobrotvorskaya and R. N. Oleïnik (*Mikrobiologiya*, 1956, **25**, 293—298).—Application of farmyard manure to meadow chernozem (20 tons per hectare) gave a 10—25-fold increase in the content of aërobic cellulose bacteria and of N-fixing and nitrifying organisms of winter wheat rhizosphere, over that found with mixtures of humus or peat (3 tons), superphosphate (150 kg.), and lime (300 kg.). Farmyard manure was twice as effective as the mixed fertilizer in increasing the yield of wheat.
R. TRUSCOE.

Antibiotic production in soil. Hideo Koike (*Dissert. Abstr.*, 1956, **16**, 1199).—No correlation existed between the ability of different actinomycetes to produce antibiotics *in vitro* and that in soil; a combination of $HgCl_2$ and streptomycin sulphate at concn. of 0·625 and 20 μg. per 0·1 ml. of assay solution, respectively, inhibited the growth of bacterial contaminants in the paper-disc plate assay technique; a new fritted-filter-tube agar-plug method of assay was developed. An actidone-producing strain of *Streptomyces griseus*, Krainsky *emend.* Waksman *et al.* failed to produce actidone in certain soils supplemented with org. substances; different soils varied in their ability to support antibiotic production from soya-bean meal. The properties of antibiotic W-S are detailed.
O. M. WHITTON.

Production of antibiotics in soil. IV. Production of antibiotics in coats of seeds sown in soil. J. M. Wright (*Ann. appl. Biol.*, 1956, **44**, 561—566).—Wheat, mustard, and pea seed inoculated with *Trichoderma viride* and buried in potting compost for five days developed gliotoxin in the seed coat. Pea seeds similarly inoculated with *Penicillium frequentans* and *P. gladioli* developed frequentin and gladiolic acid respectively in the seed coats after seven days in soil. Inoculation with three actinomycetes failed to produce an antibiotic in the coats of seeds buried in soil. Gliotoxin developed in the seed coat of peas buried in a soil containing *T. viride*.
A. H. CORNFIELD.

Isotopes in soil and fertilizer research. O. Talibudeen (*Research*, 1956, **9**, 426—435).—The application of tracer techniques to soil investigations, current analytical methods for soil constituents and preparation of labelled compounds for these purposes are reviewed. (66 references.) J. S. C.

New fields for the application of the Mitscherlich equation. I. Quantitative measure for the relative effectiveness of nutrients. A. M. Balba and R. H. Bray (*Soil Sci.*, 1956, **82**, 497—502).—A discussion. The Mitscherlich equation as modified by Bray, is again modified to deal with different soil nutrient forms. T. G. MORRIS.

Yield-of-nutrient curves and availability of phosphorus and potassium in Burford loam in the greenhouse. J. A. Smith (*Canad. J. agric. Sci.*, 1956, **36**, 339—348).—In this soil light " starter " applications of P and K suffice to produce max. yields of oats, but yields of clover–grass hay were increased by additional K and P dressings. The apparently inconsistent results are ascribed in part to the high P-fixing capacity of the soil and to its ability to release non-exchangeable K to the plants. A. G. POLLARD.

Application of nutrients to crops as leaf sprays. G. N. Thorne (*Agric. Rev., Lond.*, 1956, **2**, No. 8, 42—45).—A short review of recent work in this subject. A. G. POLLARD.

Use of glass frit for the hydroponic culture of tomatoes. E. L. Wynd and C. E. Wildon (*Lloydia*, 1955, **18**, 109—128).—Tomatoes supplied with Mg, Ca, K, P, S, B, Mo, Cu and Zn in the nutrient were grown in a glass frit rooting medium. In the controls quartz was substituted for the glass frit. The latter contained 7·5% of Fe as Fe_2O_3 and 3·0% of Mn as MnO_2 and supplied adequate amounts of Fe and Mn to the plants. L. G. G. WARNE.

Rate of decomposition of calcium cyanamide in spruce humus in comparison with NH_3 at various soil reactions. R. Themlitz (*Z. PflErnähr. Düng.*, 1956, **75**, 257—268).—Calcium cyanamide decomposes relatively quickly in forest humus. Analytical data and germination trials are in good agreement. $CaCN_2$ is fixed more than is NH_3 in acid and more so in limed humus, possibly due to a reaction between the humus and intermediates in the decomposition of $CaCN_2$. M. LONG.

Influence of particle size, water solubility, and placement of fertilizers on the nutrient value of phosphorus in mixed fertilizers. K. Lawton, C. Apostolakis, R. L. Cook and W. L. Hill (*Soil Sci.*, 1956, **82**, 465—476).—Greenhouse and field studies with a no. of crops are reported which compare the uptake of P from granular and powdered fertilizer with different water-sol. P contents, applied in bands or mixed with the soil. When granular fertilizer was thoroughly mixed with the soil the dry wt. of the crops increased with the amount of water-sol. P in the fertilizer. When powdered fertilizer was mixed with the soil the crop wt. was not appreciably affected by the water-sol. P. Wt. of crops receiving powdered fertilizer were higher than those with granular. Uptake of P by the crops was paralleled by dry matter production. When applied in a band granular fertilizer was no more effective than powder. In both cases the water-sol. P was important in controlling the uptake by the crops. In all cases a positive correlation existed between dry matter yield and water-sol. P content in the fertilizer. T. G. MORRIS.

Phosphine as a phosphatic fertilizer. F. Hunter and I. Thornton (*Nature, Lond.*, 1956, **178**, 866—867).—Used as a phosphatic fertilizer PH_3 is not toxic to germination or growth of radishes or wheat at normal dressings and, whilst soil retention is far less efficient than with NH_3, no loss to the atm. is likely. Superphosphate and PH_3 produced similar yield responses but a much higher (nearly double) uptake of P occurred from PH_3 at higher levels of application. J. S. C.

Effect of granulated phosphate fertilizers and of Phosphobacterin on composition of wheat grains. V. V. Pinevich (*Dokl. Akad. Nauk SSSR*, 1956, **108**, 157—159).—The highest yields of grain were obtained with superphosphate granules made up with org. matter (unspecified), and the grain had a higher gliadin, and a lower gluten, content than that found with other forms of P fertilizers. The total P content was highest with powdered superphosphate, but acid-sol. P was highest, and phospholipin + nucleo protein P lowest, with granulated superphosphates. No appreciable superiority of " Phosphobacterin " over granulated superphosphate fertilizer was evident. R. TRUSCOE.

Granulated triple superphosphate. G. C. Inskeep, W. R. Fort and W. C. Weber (*Industr. Engng Chem.*, 1956, **48**, 1804—1816).—A plant for direct production of a granulated triple superphosphate is described and illustrated by a flow sheet. In the continuous process, phosphate rock is treated with H_2SO_4, and the phosphoric acid produced in turn reacts with additional phosphate rock. Costs are analysed. (17 references.) O. M. WHITTON.

Determination of phosphoric acid in fertilizers. I. G. Sánchez Marco (*Inf. Quím. Anal.*, 1956, **10**, No. 4, 132—142).—The methods developed, used and recommended by different official bodies are reviewed. Their variety may lead to dispute between manufacturer and customer. D. LEIGHTON.

Hydrothermic synthesis of $FePO_4.2H_2O$ (Strengit). F. Scheffer, B. Ulrich and P. Hiestermann (*Z. PflErnähr. Düng.*, 1956, **75**, 135—143).—$FePO_4.2H_2O$ is prepared by heating 25 g. of $FeCl_3.6H_2O$, dissolved in 10 ml. of water, with H_3PO_4 (75%)(5) and 4N-HCl (20 ml.), for 72 hr. at 170°. After centrifuging and washing with 5% HCl followed by water, the product is dried at 105°. Chemical and thermal analysis, microscopical examination and the dependence of solubility on pH shows the product to be identical with " Strengit." M. LONG.

Determination of boron in boron-containing fertilizers. H. Wiele (*Z. anal. Chem.*, 1956, **151**, 270—273).—The separation of boron by distillation of methyl borate is not necessary in the colorimetric determination of B with carminic acid in the absence of nitrate. Fe^{+++} and NH_4^+ do not interfere nor do small quantities of phosphate ion but large quantities must be removed. P. S. STROSS.

Analytical applications of complexones. V. Determination of molybdenum in soils. F. Bermejo Martínez and A. Prieta Bouza (*Inf. Quím. Anal.*, 1956, **10**, No. 4, 123—131).—Interfering substances in soils which cause inaccuracy in the KCNS–$SnCl_2$ colorimetric determination of Mo are eliminated in one step. SiO_2 is removed from the calcined sample by heating with HF and H_2SO_4 and the residue after evaporation is extracted with 1 : 1 HCl. The extract, evaporated and taken up in constant-b.p. HCl, is treated with NaF and Complexone III to chelate interfering cations, boiled, cooled, diluted and shaken with equal vol. (I) of CCl_4 and amyl alcohol. The aq. layer is treated with KCNS and shaken with $SnCl_2$ in HCl, the colour extracted with more I and the extinction measured at 465 mμ. with that of a blank. The result is compared with a calibration curve. D. LEIGHTON.

Compact soil perfusion apparatus. F. M. Collins and C. M. Sims (*Nature, Lond.*, 1956, **178**, 1073—1074).—A modified apparatus for the perfusion of soil samples, without disturbing the soil during the experiment, is described. J. S. C.

Plant Physiology, Nutrition and Biochemistry

Biochemical mechanisms in phototropism. E. R. Waywood and G. A. Maclachlan (*Chem. Can.*, 1956, **8**, No. 10, 40—45).—A review of investigations relating to the metabolic interrelationships of indolylacetic acid, the mechanism of its oxidation and its rôle generally in the phototropic behaviour of plants. (17 references.) J. S. C.

Photoperiod of wintering plants, with relation to their resistance to winter conditions. A. K. Fedorov (*Dokl. Akad. Nauk SSSR*, 1956, **107**, 605—608).—Winter wheats sown in spring respond to summer illumination conditions in much the same way as do spring wheats. Under autumn and early spring conditions of illumination, differentiation of the growth cone is considerably retarded for winter wheats, which are for this reason less susceptible to frost damage. R. TRUSCOE.

Influence of light and darkness on carbon dioxide fixation [by plants]. S. P. Sen and A. C. Leopold (*Plant Physiol.*, 1956, **31**, 323—329).—The dark fixation of CO_2 is influenced by the previous light periods and also by the preceding dark period. The bearing of experimental observations of these factors on the photoperiodism of long- and short-day plants is discussed. A. G. POLLARD.

Effects of the photoperiod on the shoot growth of cherry seedlings. L. Smeets (*Euphytica*, 1956, **5**, 238—244).—With first-year seedlings many plants (at 20°) terminated their growth at the same time with 8- and 16-hour photoperiods. With a few of the seedlings 8-hour photoperiods induced earlier and 16-hour photoperiods later cessation of shoot growth. With 2-year seedlings shoot growth ceased at the same time under 8-, 16- and 24-hour photoperiods. L. G. G. WARNE.

Effects of photoperiods on growth and pithiness of radishes. O. Banga and L. Smeets (*Euphytica*, 1956, **5**, 196—204).—Two varieties (Cherry Belle, resistant to pithiness, and No. 6205, an early variety prone to pithiness) were used. With 19- and 24-hour photoperiods bolting was accelerated but was very slow with 8-, 10- and 12-hour photoperiods. Photoperiod had no direct effect on pithiness, but pithiness increases with increased root size. Long days, in cases where bolting had not been induced, increased root size and thus indirectly accelerated the development of pithiness. L. G. G. WARNE.

Biosynthesis of indolylacetic acid in the styles and ovaries of tobacco preliminary to the setting of fruit. H. A. Lund (*Plant Physiol.*, 1956, **31**, 334—339).—In tobacco the pollen tubes carry to styles and ovaries amounts of those enzymes which convert tryptophan into indolylacetic acid and thus initiate seed formation. A. G. POLLARD.

Similarity of some kinetin and red light effects. C. O. Miller (*Plant Physiol.*, 1956, **31**, 318—319).—Data are presented demonstrating the similarity of the kinetin (6-furfurylaminopurine) and red-light effects on bean leaf expansion and lettuce seed germination. E. G. BRICKELL.

Promotion of leaf expansion by kinetin and benzylaminopurine. R. A. Scott, jun. and J. L. Liverman (*Plant Physiol.*, 1956, **31**, 321—322).—Leaf expansion is promoted by 6-(2-furfuryl)- and

benzylaminopurine and by Co even in cases in which the promotive effect of red light is reversed by far-red light. E. G. BRICKELL.

Seed and seedling mortality. V. Direct and indirect influence of low temperatures on the mortality of maize. J. L. Harper (*New Phytol.*, 1956, **55,** 35—44).—Maize was sown in pots and kept for 0 to 6 days at 20° and then exposed to temp. of −10 to 20°. Temp. of −10° and −50° were lethal to all grain pretreated at 20°. In grains not pre-treated at 20°, 0° was more lethal than the lower temp. and when pre-heated, mortality was reduced when the period of treatment was extended to 4 or 6 days. At 0° pathogenic damage was important but reached a max. at 5°. L. G. G. WARNE.

Vitamins in germination. Determination of free and combined inositol in germinating oats. A. Darbre and F. W. Norris (*Biochem. J.*, 1956, **64,** 441—446).—Inositol in germinating oats is determined by *Schizosaccharomyces pombe*, which is unaffected by fats, fatty acids and choline. Methods for the assay of total and free inositol are described. During germination there is a net loss of inositol; a decrease in bound forms of inositol is only partly compensated by an increase in free inositol. Lipin inositol is present only in small amounts and is separated and assayed with difficulty. J. N. ASHLEY.

Fat metabolism in higher plants. VII. β-Oxidation of fatty acids by groundnut mitochondria. P. K. Stumpf and G. A. Barber (*Plant Physiol.*, 1956, **31,** 304—308).—Mitochondria prepared from cotyledons of germinating groundnuts can degrade short- and long-chain fatty acids by β-oxidation, the co-factor requirements being adenosine triphosphate, diphosphopyridine nucleotide, coenzyme A, triphosphopyridine nucleotide, Mn, a tricarboxylic acid cycle acid and glutathione. E. G. BRICKELL.

Induction of chromosome division by ascorbic acid treatment. A. K. Sharma and A. Datta (*Phyton*, 1956, **6,** 71—78).—Ascorbic acid treatment (optimum concn. 0·05M) induced mitosis in tetraploid cells of permanent tissue of onion roots. L. G. G. WARNE.

Biogenesis of secondary plant substances in common rue, *Ruta graveolens*. E Sprecher (*Planta*, 1956, **47,** 323—358).—The course of synthesis and distribution of essential oils and certain pigments during the growth of the plants are examined. A. G. POLLARD.

Inter-relationship of alkaloid content and stage of development of one- and two-year-old *Atropa belladonna*. G. Elzenga and J. W. de Bruyn (*Euphytica*, 1956, **5,** 259—266).—One-year-old-plants have a max. alkaloid content during and just after flowering. In two-year-old plants alkaloid content reaches a max. early in the season, falls to a low level at flowering and rises again to a high value when the plant is bearing green fruits. L. G. G. WARNE.

Influence of temperature on growth and alkaloid content of first-year *Atropa belladonna*. G. Elzenga, L. Smeets and J. W. de Bruyn (*Euphytica*, 1956, **5,** 276—280).—Plant development was more rapid at 23° than at 20° or 26°. The alkaloid content too was highest in the plants grown at 23°. L. G. G. WARNE.

Paper chromatographic study of flavonoids of the polyphenol fraction of tobacco. M. K. Mikhailov (*Dokl. Akad. Nauk SSSR*, 1956, **108,** 511—514).—Two-dimensional paper chromatography of ethanol extracts of tobacco leaf showed five flavonols (rutin and *iso*quercitrin identified) and six coumarin substances. Hydrolysates of the extracts contained quercitin and three other unidentified flavonol aglycones. R. TRUSCOE.

Formation and decomposition of tomatin in tomato plants. H. Sander (*Planta*, 1956, **47,** 374—400).—The formation, distribution and metabolism of tomatin in the plants are examined. The possible physiological activities of tomatin in the plant system are discussed. A. G. POLLARD.

Phytochemical examinations of the leaves of *Carica papaya*. W. F. Head, jun. and W. M. Lauter (*Econ. Bot.*, 1956, **22,** 258—260).—Steroidal saponins and phenols were absent from the leaves of both male and perfect flowered *Carica* plants. A small amount of flavonol was present in the leaves of perfect flowered plants and about 0·5% tannin, 0·6% organic acid, 0·14% alkaloid and a trace of unsaturated sterols in both types of leaves. Carpaine was isolated from the leaves and identified. L. G. G. WARNE.

Influence of coniferin and syringin on lignification processes in cultures of cambial tissue of two woody species. F. Barnoud (*C. R. Acad. Sci., Paris*, 1956, **243,** 1545—1547).—Cambial tissues of *Syringa vulgaris* and *Rosa wichuraiana*, held in culture for several years, were immersed in media containing the precursor glucosides of lignin, coniferin and syringin and the influence of each on the lignification of the tissues was observed. Coniferin and syringin did not appear to have any modifying effect on the differentiation of ligneous cells but manifested themselves by an enrichment of the lignin mol. synthesized by the tissues. This enrichment was small in the case of tissues which had retained in culture the faculty of lignification but significant for tissues which had lost this faculty. J. S. C.

Comparison of [plant] composition calculated for consecutively harvested or otherwise different samples. N. Hellström (*Acta agric. scand.*, 1956, **6,** 141—144).—A mathematical consideration of a system for increasing the accuracy of comparison of composition of samples taken at different times or under different circumstances. A. G. POLLARD.

Dose-effect relationships in *X*-irradiated barley embryos. L. W. Mericle, V. R. Phelps and A. C. Wheeler (*Genetics*, 1955, **40,** 585).—Developing barley embryos were subjected to *X*-rays. The least mature were affected by doses as low as 200 r, whilst nearly mature embryos showed little or no effect with 500 r. Effects are described. L. G. G. WARNE.

Comparison of the effects of 8-ethoxycaffeine and *X*-rays on cytology and growth of roots of *Vicia faba*. J. Read and B. A. Kihlman (*Hereditas*, 1956, **42,** 487—507).—Both treatments caused chromosomal aberrations in the root tip cells and the frequency of these agreed quant. with the reduction in root growth observed. L. G. G. WARNE.

Distribution of mineral elements in the tea plant after their absorption from the soil. R.Kh. Aĭdinyan (*Dokl. Akad. Nauk SSSR*, 1956, **107,** 741—743).—One strand of the root system of 6-year-old tea plants was isolated in soil to which ^{32}P, ^{35}S and ^{45}Ca had been added, and the activity of leaves and stalks at different levels was determined at different times up to 24 days thereafter. The ^{32}P was found in only one of the leaf-levels, and the ^{35}S and ^{45}Ca in another. Activity was highest for ^{32}P in the most rapidly growing parts of the leaves and in buds. ^{45}Ca was found chiefly in the leaf veins, from which ^{35}S was absent. Particular parts of the root system probably supply soil elements to particular parts of the leaf system, hence mineral fertilizers should be introduced evenly around tea plants, rather than in strips along the rows. R. TRUSCOE.

Uptake of ^{32}P-labelled potassium dihydrogen phosphate by wheat leaves. K. Kaindl (*Bodenkultur*, 1956, **9,** 43—49).—Three periods give best response to leaf application of phosphate, notably that between the 4th and 8th week after cultivation. M. LONG.

Determination of phosphatide-P in plant tissue. W. Wenzel (*Z. PflErnähr. Düng.*, 1956, **75,**143—161).—The method devised serves to separate phosphatide-P from lipoprotein complexes, inorg. P and protein P. The tissue is extracted with methanol, the extract being evaporated and the residue treated with benzene–0·1N-HCl which decomposes lipoprotein complexes. The benzene layer contains the purified phosphatide fraction, whilst the aq. layer includes some water-sol. phosphatide. The aq. layer is subjected to adsorption filtration which leaves phosphatides and org. P in solution. M. LONG.

Identification of phosphorylcholine as an important constituent of plant saps. J. V. Maizel and A. A. Benson (*Plant Physiol.*, 1956, **31,** 407—408).—Phosphorylcholine is the principal P ester in plant saps and probably acts as a P carrier to which plant membranes are permeable. A. G. POLLARD.

Determination of phytin, protein and inorganic phosphorus in plant tissue. W. Wenzel (*Z. PflErnähr. Düng.*, 1956, **75,** 191—203).—The tissue is first extracted with methanol which dissolves phosphatide-P. The extract must also be subjected to analysis for the other types of P, as these are also extracted to a slight extent. Phytin and inorg. P are extracted by 2·5N-HCl, the latter being determined directly in the decolorized solution. The protein-P is in the residue from the HCl extraction. P esters are grouped with the phytin fraction and nucleic acids with the protein fraction, both occurring only in small quantities. M. LONG.

Boron deficiency symptoms in sunflowers. W. Bussler (*Z. PflErnähr. Düng.*, 1956, **75,** 97—114).—The effects on all parts of the plant of B deficiency are studied. Symptoms of deficiency first appear in the stem apices in contrast to that of N, P, K, Mg or Zn, owing to fixation in tissues and lack of transport of B to rapidly growing tissue. Disturbance of the conversion of embryonic cells to permanent tissue, caused by the absence of B, is the reason for terminal bud death, stem thickening, rosette appearance, abnormal leaf colour, deformation, fall, brittleness and necrosis. M. LONG.

Boron toxicity induced in a New Jersey peach orchard. I. H. R. Cibes, E. Hernandez and N. F. Childers (*Proc. Amer. Soc. hort. Sci.*, 1955, **66,** 13—20).—Excess B applied to young peach trees induced withering and dieback of shoots, small canker areas with gum exudation in the crotches, rough bark, prominent lenticels and excessive development of lateral shoots. Flower bud formation and fruit set were reduced especially when Mn or Cu were deficient. Excess B and deficiencies of Fe, Mn, Cu and Zn all accelerated fruit ripening. Mn-deficient trees were generally high in B, and B-deficient trees high in Mn. L. G. G. WARNE.

Absorption of cobalt-60 by leaves of bean plants in the dark. F. G. Gustafson and M. J. Schlessinger, jun. (*Plant Physiol.*, 1956, **31**, 316—318).—Radioactive Co enters the bean leaf to which it is applied but after 6 hr. is still found predominantly in the tissue immediately adjacent to the area of application. E. G. BRICKELL.

Iron supply and interacting factors related to lime-induced chlorosis. J. C. Brown and R. S. Holmes (*Soil Sci.*, 1956, **82**, 507—519).—Milo and soya-beans were grown on three calcareous soils, on one of which chlorosis had developed in the field. Various sources of Fe were supplied, viz., diethylenetriaminepenta-acetate (DTPA), aromatic-amino polycarboxylate (APCA) and radio-Fe^{***} chloride. DTPA and APCA was absorbed better by soya-beans than by milo. In solution cultures DTPA was ineffective as a source of Fe for milo. The amount of Fe absorbed by both soya-beans and milo was related to the amount of water-sol. Fe in the soil. This applied to both treated and untreated soils. Chlorosis in milo was corrected by $FeSO_4$. T. G. MORRIS.

Treatment of chlorosis in plants. G. Gasser and G. Müller (*C. R. Acad. Agric. Fr.*, 1956, **42**, 713—717).—Methods to control chlorosis are discussed, including recent work on chelates. E. M. J.

Nature of the interaction between iron and molybdenum or vanadium in nutrient solutions with and without the growing plant. K. Warington (*Ann. appl. Biol.*, 1956, **44**, 535—546).—Iron offset the toxicity (to peas and soya-beans) of Mo or V in nutrient solutions more effectively when it was supplied at the same time as the Mo or V than when it was given separately on alternate 3-day periods. Allowing nutrient solutions of pH 4·6 containing high concn. of Fe, with or without V, to stand for four days before use did not delay the restoration of colour to chlorotic plants, but even two days' standing reduced the Fe content of their roots and the V content of both shoots and roots. V had little effect on Fe uptake. In similar tests with Mo, a delay of 7—9 days before use of the solution retarded colour recovery, but shorter periods had no effect. A delay of two or more days greatly reduced the Fe content of the root, but the Mo content was unaffected or increased. High [Mo] greatly increased the Fe in the root, but had little effect on that of the shoot. Pptn. of Fe in the nutrient solution was delayed by high concn. of either $(NH_4)_2MoO_4$ or Na_2MoO_4 if the initial pH was 4·6, but not if it was 6·6. V ($VOCl_2$) had no influence on the pptn. of Fe at pH 4·6. At least part of the compensating action of Fe on Mo or V toxicity takes place outside the plant. A. H. CORNFIELD.

Effects of manganese nutrition of higher plants on growths, iron-porphyrin, enzymes, oxaloacetic acid decarboxylation, indolylacetic acid inactivation and ascorbic acid content. J. P. Winfree (*Dissert. Abstr.*, 1956, **16**, 1311).—Literature on Mn catalysis in plant metabolism is reviewed. Experiments with soya-beans and tomatoes are described. With soya-beans, low Mn supply markedly reduced the yields and oil content of beans and dry wt. of stems, petioles and roots; with very low Mn levels, the average size and wt. of the beans was lower and the total N content was much higher than when plants received the higher Mn levels. The Fe-porphyrin enzymes catalase and cytochrome oxidase respond to Mn in an inverse manner, but not to the same relative degree as do growth and yield. Mn may be the dominant cation associated with an oxalo-acetic acid decarboxylase of soya-bean leaves. Mn appears to affect the indolylacetic acid balance by a direct action on peroxide production. In tomato, the level of Mn nutrition is reflected in the ascorbic acid content of the ripe fruits; Fe–Mn relationships may be the controlling factor. G. HELMS.

Adsorption of zinc sulphate in Thompson Seedless grape canes. W. B. Hewitt and M. E. Gardner (*Plant Physiol.*, 1956, **31**, 393—399).—Solutions containing $^{65}ZnSO_4$ were made to pass through cut lengths (1·5—2·3 m.) of grape canes. Adsorption of Zn occurred largely on the walls of the vessels to extents which increased with the pH of the solution. A. G. POLLARD.

Absorption of radio-zinc by young coffee plants (*Coffea arabica*, L.) grown in nutrient solution. E. Malavolta, J. P. Arzolla and H. P. Haag (*Phyton*, 1956, **6**, 1—6).—High levels of supply of Mn, Cu and Mo (but not of Fe) reduced the intake of Zn. L. G. G. WARNE.

Preliminary results of treating rosetted pecan trees with chelated zinc. A. O. Alben (*Proc. Amer. Soc. hort. Sci.*, 1955, **66**, 28—30).—The Zn salt of ethylenediaminetetra-acetic acid applied to the soil at the rate of 1 lb. per tree was as effective as 20 to 30 lb. of $ZnSO_4$ in curing "rosetted" pecan trees. L. G. G. WARNE.

Factors affecting absorption and translocation of zinc in citrus plants. E. F. Wallihan and L. Heymann-Herschberg (*Plant Physiol.*, 1956, **31**, 294—299).—Absorption and translocation occurred more rapidly in young leaves than in old leaves, varied directly with concn. per unit area, and was more rapid when Zn was applied at the centre of the leaf. Ultimate distribution of applied Zn was independent of whether it was absorbed by the roots or by the leaves. Chelated forms of Zn gave better penetration through soil than did inorg. salts. E. G. BRICKELL.

Rapid, direct polarographic determination of zinc in plant ash solutions. H. L. Barrows, M. D. Rosdoff and A. H. Gropp (*J. agric. Food Chem.*, 1956, **4**, 830—853).—Solutions of plant ash in dil. HCl (Zn concn. 0·003—0·16 mM.) are directly polarographed. An aliquot of the solution is mixed with a highly ammoniacal solution of KCl, Na_2SO_3 and gelatin and the polarogram is recorded from this solution. There is no interference from normal concn. of Mn^{II}, Ni^{II}, Co^{II}, Cd^{II}, Cr^{III}, Al^{III} or Fe^{III}, occurring in plant tissue. (15 references.) N. M. WALLER.

Effects of a series of cycles of alternating low and high soil water contents on the rate of apparent photosynthesis in sugar cane. F. M. Ashton (*Plant Physiol.*, 1956, **31**, 266—274).—There was a progressive increase in the daily cumulative rate of photosynthesis from the first to the fifth cycle, each cycle consisting of seven days of high soil water content maintained by daily irrigation, followed by drying to the permanent wilting %. A progressive decrease in the interval of time before the plant showed the first increase in rate of photosynthesis was also noted and an overnight recovery of photosynthesis occurred even when the soil water content was at the permanent wilting %. E. G. BRICKELL.

Growth of barley embryos in coconut milk media. K. J. Norstog (*Bull. Torrey Bot. Club*, 1956, **83**, 27—29).—Coconut milk contains a factor essential for the formation of root and leaf primordia in barley embryos and embryos 0·3 mm. long placed in Whites medium plus 90% coconut milk develop normally. L. G. G. WARNE.

Effect of thiol inhibitors on rubidium absorption by excised mung bean roots. T. Tanada (*Plant Physiol.*, 1956, **31**, 403—406).—Absorption of Rb (with ^{86}Rb as tracer) by roots from culture solutions was increased markedly by certain —SH inhibitors, e.g., Cu^{**} and HgPh salts, in absence of Ca but was lowered in presence of Ca. The mechanism of these effects is discussed. A. G. POLLARD.

Uptake and translocation of streptomycin by peach seedlings. M. H. Dye (*Ann. appl. Biol.*, 1956, **44**, 567—575).—Streptomycin (**I**) was absorbed by peach seedlings from nutrient cultures containing the antibiotic and was translocated to the leaves. Lower leaves contained much more **I** than did upper leaves and extent of uptake was correlated with concn. of **I** in the solution and with time. Apical growth of peach seedlings was not affected following immersion for 24—48 hr. in **I** (25 p.p.m.), but was considerably reduced or inhibited with 50 p.p.m. Chlorosis and necrosis of leaves and stems occurred. A. H. CORNFIELD.

Atmospheric fluoride: its uptake and distribution in tomato and maize plants. I. A. Leone, E. Brennan and R. H. Daines (*Plant Physiol.*, 1956, **31**, 329—333).—Comparison is made of the absorption of HF by maize and by tomato plants and of the resulting injury from exposure to small HF concn. Maize was more sensitive to injury but tomato tended to absorb and assimilate the greater proportion of HF. Factors affecting the absorption and retention of HF are examined. A. G. POLLARD.

Vernalization in peas. H. R. Highkin (*Plant Physiol.*, 1956, **31**, 399—403).—Vernalization (4—7° for 30 days) of germinating seeds for promotion of flowering is a separate process from vernalization for vegetative growth. Pretreatment of germinating seeds at a higher temp. (20° for >3 days or 26° for >1 day) rendered them insensitive to subsequent vernalization for flowering but had little or no effect on vernalization for vegetative growth. A. G. POLLARD.

Vernalization of some leguminous plants, especially of hairy vetches. H. Kurth (*Euphytica*, 1956, **5**, 63—70).—*Vicia villosa*, *V. pannonica* and *V. sativa* seed vernalized at 1—5° for 14 to 35 days gave plants showing slightly accelerated flowering. In *V. villosa*, seed production was greatly increased and yields of straw decreased. Early spring outdoor sowing also increased seed yields but without reducing the yield of straw. L. G. G. WARNE.

Plant growth-regulating substances. X. Activity of some 2 : 6- and 3 : 5-substituted phenoxyalkanecarboxylic acids. J. Toothill, R. L. Wain and F. Wightman (*Ann. appl. Biol.*, 1956, **44**, 547—460).—Pea curvature, *Avena* cylinder elongation and tomato-leaf epinasty tests were used for assessing biological activity of a number of phenoxy-acids possessing halogen or methyl substituents in the 2 : 6- or 3 : 5-positions of the nucleus. In general 3 : 5- was more closely associated than 2 : 6- substitution with inactivity. The introduction of a further halogen atom into the 4-position did not enhance activity in the 2 : 6-compounds but did so in the 3 : 5-compounds. Although the 2 : 4 : 6-trichloro- and 2 : 4 : 6-tribromo-phenoxyacetic acids were almost inactive, 2 : 4-dichloro-6-fluoro- and 2 : 4-dibromo-

6-fluoro-phenoxyacetic acids were very highly active. Activity was increased when a CH_3 group was substituted into the side-chain of certain phenoxyacetic acids possessing 2 : 6-substituents. Some of the results conflict with recent theories on the mode of action of phenoxy-acids. A. H. CORNFIELD.

Plant growth-regulating activity in certain carboxylic acids not possessing a ring structure. C. H. Fawcett, R. L. Wain and F. Wightman (*Nature, Lond.*, 1956, **178,** 972—974).—A series of carboxymethyl *O*-alkylxanthates was synthesized and the *tert.*-butyl derivative was significantly active in promoting the growth of 1-cm. wheat coleoptile sections. In many instances, chloro- and methyl-substituted acetic acids also showed significant activity. Ethylenediaminetetra-acetic (**I**) was much less active than indol-3yl-acetic acid. Ethyl alcohol, similarly tested, showed the same low order of growth response as did **I**, the highest activity being observed at a concn. just below the level at which toxic symptoms were observed. The action of these substances is not typical of a normal auxin response but certain types of non-ring structure, e.g., dimethyl-dithiocarbamate deriv., are probably capable of inducing a true auxin response. J. S. C.

Effect of naphthaleneacetic acid on the transpiration of Jonathan apple shoots. V. W. Kelley (*Proc. Amer. Soc. hort. Sci.*, 1955, **66,** 65—66).—Sprays of naphthylacetic acid (30 p.p.m.) increased the transpiration rates of apple and peach shoots. L. G. G. WARNE.

Residual effect of auxin on the [plant] cell wall. R. Cleland and J. Bonner (*Plant Physiol.*, 1956, **31,** 350—354).—Experimental evidence indicates that auxin acts primarily by loosening the walls of cells which then absorb water and expand osmotically. This action takes place only under aërobic conditions and although the effect persists through following anaërobic periods, a sustained auxin supply is needed. Anti-auxins applied during cell expansion partly inhibit the action. A. G. POLLARD.

Fate of 2 : 4-dichlorophenoxyacetic acid in bean seedlings. I. Recovery of the acid and its breakdown in the plant. J. R. Hay and K. V. Thimann (*Plant Physiol.*, 1956, **31,** 382—387).—When applied to a primary leaf of a bean seedling 2 : 4-D disappeared rapidly, more quickly in daylight than in darkness. A method for the extraction and assay (slit pea test) of 2 : 4-D is described. A. G. POLLARD.

Effect of 2 : 4-dichlorophenoxyacetic acid and other growth regulators on the formation of a red pigment in Jerusalem artichoke tuber tissue. C. R. Swanson, S. B. Hendricks, V. K. Toole and C. E. Hagen (*Plant Physiol.*, 1956, **31,** 315—316).—A red pigment, very slightly sol. in water but soluble in MeOH, pyridine and dioxan, is induced in *Helianthus tuberosus* by 2 : 4-D. Indolylacetic acid, 2-methyl-4- and 2-methyl-3-chlorophenoxyacetic and 2 : 4 : 5-trichlorophenoxyacetic acids behaved similarly. $Cu^{\cdot\cdot}$ (10 mg./l.) and 2 : 4-dinitrophenol enhanced the expression of the pigment; KCN or Na diethyldithiocarbamate (10 mg./l.) caused inhibition. The pigment may be of a phenolic or quinonoid structure and an intermediate in a browning reaction. E. G. BRICKELL.

Action of 2 : 3 : 5-triiodobenzoic acid and 2 : 4 : 6-trichlorophenoxyacetic acid on the abscission of leaf petiole stumps. B. Haccius and H. Nies (*Planta*, 1956, **47,** 613—624).—Low concn. of triiodobenzoic (**I**) and 2 : 4 : 6-trichlorophenoxyacetic acids restricted abscission as do typical growth-substances. Higher concn. had the reverse (anti-auxin) effect. **I** was the more active acid in this respect. The critical concn. between inhibitory and direct effects varied with the plant species examined. Abscission is probably regulated not only by the translocation of growth-substance from the leaf blade but also by inhibitory substance(s) occurring naturally in the remaining plant parts. A. G. POLLARD.

Effect of "Rindite" on development of growth-substances in potato tubers. M. B. Varga and L. Ferenczy (*Nature, Lond.*, 1956, **178,** 1075).—Tubers were treated with "Rindite" (ethylene chlorohydrin–ethylene dichloride–carbon tetrachloride 7 : 3 : 1) and the growth-substances extracted and examined chromatographically. Chromatograms of the acid fractions revealed the presence of indol-3-ylpyruvic acid, indol-3-ylacetic acid, indol-3-ylacetonitrile and two unidentified substances; those of the non-acid fractions showed the presence of indol-3-ylacetaldehyde. J. S. C.

Effect of defoliation on leaf initiation and early growth of leaf initials (in strawberry). S. E. Arney (*Phyton*, 1956, **6,** 109—120).—Removal of all or of the three youngest leaves accelerates the emergence of new leaves. This accelerating effect is counteracted by indolylacetic acid applied to the cut ends of the petioles from which the leaf blades have been removed. L. G. G. WARNE.

Growth and development in the genus *Fragaria*; effect of defoliation on leaf growth. S. E. Arney (*Phyton*, 1955, **5,** 93—105).—Strawberry plants were defoliated by removing one, two or three of the youngest or all leaves, the effect being nearly as great as that of complete defoliation. Cell size and the rate of emergence of the next two leaves may be increased. Application of indolylacetic acid to decapitated petioles almost neutralizes the effect of defoliation. L. G. G. WARNE.

Simple technique for the coleoptile cylinder test. O. Kiermayer (*Planta*, 1956, **47,** 527—531).—A modified method for the assay of growth substances is described. It is specially designed for use in conjunction with paper-chromatographic investigation. A. G. POLLARD.

Crops and Cropping

Cultural and chemical aspects of crop production: soilless cultivation and its application to crop production. R. H. Stoughton (*Chem. & Ind.*, 1956, 1175—1178).—Solution-culture, sub-irrigation and sand-culture systems of soilless culture are reviewed. J. S. C.

Fractionation of total supplies of nitrogen, phosphorus and potassium in certain Kansas surface soils and subsoils and their effect on the yield and composition of wheat. M. S. Bhangoo (*Dissert. Abstr.*, 1956, **16,** 1196—1197).—The analytical characters of the soils (especially N, P and K) are detailed. In general wheat yields were increased by PK, NP and NPK treatments on most soils, and P alone or N alone gave good responses on some. Little K was needed in most cases. Results are given for the effects on composition of straw and grain of applications of N, P and K. O. M. WHITTON.

Chemical composition and nutrient uptake of maize. H. Weinmann (*Rhod. agric. J.*, 1956, **53,** 168—181).—Application of P to a reddish-brown clay soil increased slightly the P content of the grain but had little influence on other constituents of the grain and stover. The K content of the stover was highly correlated with exchangeable soil K. Ear dry wt. increased during the period of grain formation; dry matter yield of stover increased only up to the early dough stage. Uptake of N, P, K and Ca by the above-ground portion continued up to the early dough stage. All of the N and P absorbed during the initial stages of grain formation was transferred to the developing ears, but 50% of the K and nearly all the Ca absorbed remained in the stover. Most of the N lost by the stover in the final stages of maturation was recovered in the ears. K and Ca were translocated from stems to roots during maturation. A. H. CORNFIELD.

Spray irrigation of potatoes. I. G. Inglis and D. J. Fergusson (*Tasmanian J. Agric.*, 1956, **27,** 220—228).—Spray irrigation together with heavier fertilizer applications increased yields of potatoes by an average of 140% at some locations. The economics aspects of treatment are considered. A. H. CORNFIELD.

Determination of dry matter and starch content of potatoes with particular consideration of the relation with specific weight. L. Gisiger and A. Metzger (*Z. PflErnähr Düng.*, 1956, **75,** 204—216).—Dry matter and starch were determined on 20-g. aliquots of pulped potato. The dry matter content rises to a max. in a layer between the centre and the skin of the potato. The regression for the relation between sp. wt. and % of dry matter is given as % dry matter = 191·33 × specific weight − 185·143; average error ± 0·69%; and that for sp. wt. and % starch = 175·295 × specific weight − 173·286; average error ± 0·58%. With increasing sp. wt., the content of matter other than starch increases at a slower rate than that of starch. M. LONG.

Improved storage quality of potatoes exposed to γ-radiation. K. Mikaelsen and L. Roer (*Acta agric. scand.*, 1956, **6,** 145—154).—Irradiation with 10,000—20,000 r prevented sprouting and visible shrinkage of tubers stored for 1 year, without harmful effects on their flavour. Treatment with a commercial growth inhibitor did not prevent sprouting for this period and the tubers were inedible after 1 year. A. G. POLLARD.

Dormancy and sprouting of potatoes. W. G. Burton (*Food Sci. Abstr.*, 1957, **29,** 1—12).—A review with 112 references. A. G. POLLARD.

Fertilizers and nutrient values of hays. I. Sulphur-deficient grey wooded soils. C. F. Bentley, L. Gareau, R. Renner and L. W. McElroy (*Canad. J. agric. Sci.*, 1956, **36,** 315—325).—Application of S-bearing fertilizers to the S-deficient soils markedly increased the yields of legume hay and its S and often its protein contents even when no N was given. Rabbits grew faster when fed the hay from treated soils than when that from control soils was used. No relationship was apparent between the composition of the hay and its effect on rabbit growth. A. G. POLLARD.

Trace element trials in a New South Wales plant nutrition survey. R. G. Weir, F. Hartridge and R. G. Fawcett (*Agric. Gaz. N.S.W.*, 1956, **67,** 2—7, 42—43).—Methods used in the survey are described.

54 of 89 trials indicated that P was necessary for establishment and maintenance of good pastures. Responses to lime were obtained in 21 cases, whilst definite responses to Mo occurred in 11 cases. These responses usually occurred in high-rainfall areas on acid soils derived from sedimentary rocks. In a few trials apparent responses to some other trace elements were obtained.
A. H. CORNFIELD.

Grazing intensity: its effect on botanical composition. D. D. Kydd (*Agric. Rev., Lond.*, 1956, **2**, No. 8, 25—30).—Controlled grazing (time and period) and fertilizer treatment may produce extensive changes in the botanical composition of pasture herbage and can be utilized to improve nutrient values.
A. G. POLLARD.

Effect of nitrogen and phosphorus on yields and composition of Napier grass. K. B. Addison (*Rhod. Agric. J.*, 1956, **53**, 491—506).—The effects of applying $(NH_4)_2SO_4$ (100—200 lb. N) and superphosphate (38—76 lb. P per acre) in all possible combinations each season on yields and chemical composition of Napier grass on a clay loam (pH 5·3) over four years are reported. Where no P was applied yields increased with N applications during the first two years only. Where P was applied yields increased with N applications in all years. Good yield responses were obtained from P applications only where N was also applied. The % of protein in the herbage increased with N and decreased with P applications. The % of P in the herbage increased with P and decreased with N applications, but total uptake of P per acre increased with both N and P applications. A. H. CORNFIELD.

Potassium deficiency in Tasmanian pastures. D. F. Paton (*Tasmanian J. Agric.*, 1956, **27**, 189—204).—Field and pot tests showed that many Tasmanian soils are deficient in K for satisfactory pasture growth. P deficiency was almost invariably associated with K deficiency, lime and Mo deficiencies occurred frequently, whilst Cu, Zn and B deficiencies were also found. K deficiency symptoms of four species of clover are described and illustrated.
A. H. CORNFIELD.

Effect of intensity of defoliation on regrowth of pasture. R. W. Brougham (*Aust. J. agric. Res.*, 1956, **7**, 377—387).—Pasture comprising ryegrass, red clover and white clover, was subjected to different intensities of defoliation by cutting down to 1, 3 and 5 in. Defoliation to 1 in. gave light interception, 1 in. above ground, of 95% or over, approx. 24 days after cutting. Pastures defoliated to 3 and 5 in., respectively, intercepted almost all the incident light 16 and 4 days after cutting. The rate of growth increased until complete light interception was approached and thereafter a nearly constant max. rate was sustained. Leaf efficiency (rate of increase of herbage dry wt. per unit area of leaf) was initially lower following severe defoliation. It increased rapidly to a max. and then declined gradually. Max. efficiency in the 3- and 5-in. cutting was attained when max. growth rate was first reached, but for pasture defoliated to 1 in., it reached a max. during the phase of accelerating growth. (10 references.) R. H. HURST.

Effect of temperature of dehydration on the proteins of lucerne. R. E. Beauchene (*Dissert. Abstr.*, 1956, **16**, 1204).—In a simple rapid procedure for determining α-amino-N in lucerne meal hydrolysates, the Cu complexed by amino-acids is measured by the flame-photometer. Meal dried at low temp. (50°) contained less protein but more α-amino-N than meal dried commercially at high temp. The latter contained no water-sol. protein, and had no proteolytic activity in contrast to the former meal. No differences in the digestibility of the meals was obtained with a high level of pancreatin but with a low level the low-temp. meal liberated α-amino-N faster than the high-temp. meal. O. M. WHITTON.

Effect of lime–superphosphate mixtures on yields of subterranean clover. J. T. Moraghan (*Agric. Gaz. N.S.W.*, 1956, **67**, 271).—Yields of subterranean clover in a P-deficient soil were increased to about the same extent by application of superphosphate, superphosphate–$Ca(OH)_2$ (4 : 1), mixed two months prior to application, or superphosphate–$CaCO_3$ (1 : 1). Yields were much poorer when the superphosphate : $Ca(OH)_2$ ratio was narrower than 4 : 1.
A. H. CORNFIELD.

Establishment of subterranean clover. J. M. Arthur and H. V. Jenkins (*Agric. Gaz. N.S.W.*, 1956, **67**, 170—175).—Subterranean clover became established and grew satisfactorily on the big scrub, chocolate basalt, sandy and yellow-brown clay soils of the Far North Coastal area providing suitable strains of seed were used and that the seed was inoculated with the correct strain of root-nodule bacteria. All soils required P at planting time and in addition the big scrub soils required Mo. In the second and subsequent years superphosphate was necessary for good growth whilst some areas of big scrub, sandy and yellow-brown clay soils required K.
A. H. CORNFIELD.

Influence of post-harvest ripening of McIntosh apples on the yield, composition and flavour of the juice. W. D. Powrie and E. A. Asselbergs (*Canad. J. agric. Sci.*, 1956, **36**, 349—355).—During the ripening of the fruit the acidity and ascorbic acid contents of the juice diminished and the pH and reducing sugar contents increased. The sol. solids content increased to a max. (18 days) and thereafter diminished progressively. The proportion of volatile reducing and of aromatic substances increased during ripening but the tannin content remained unchanged. A. G. POLLARD.

α-Naphthylacetamide: a chemical fruit thinner. D. Alderman (*Proc. Amer. Soc. hort. Sci.*, 1955, **66**, 57—64).—Sprays of α-naphthylacetamide (25 to 75 p.p.m.) given 6—28 days after full bloom show promise as "fruit thinners" on apples. A concn. of 50 p.p.m. was as effective as 75 p.p.m. and the effect diminished as the period between full bloom and the spray application was increased. There was a very marked differential varietal response.
L. G. G. WARNE.

Trace element nutrition in deciduous orchards and vineyards. E. Beyers (*Fmg S. Afr.*, 1956, **32**, No. 3, 33—38, 41).—Symptoms of deficiencies of Zn, Cu, Fe, Mg and Mn in peach, apricot, apple, pear, plum and prune, together with appropriate remedial measures are summarized. A. G. POLLARD.

Effect of certain thinning materials on number of fruit buds formed in Elberta and Halehaven peaches. V. W. Kelley (*Proc. Amer. Soc. hort. Sci.*, 1955, **66**, 67—69).—Sprays of naphthylacetic acid, naphthylacetamide and 3-chloro*iso*propyl *N*-phenylcarbamate (concn. not given) applied to peaches at different stages of fruit development reduced the no. of flower buds formed.
L. G. G. WARNE.

Fertilizer applications as related to nitrogen, phosphorus, potassium, calcium and magnesium utilization by peach trees. B. L. Rogers, L. P. Batjer and H. D. Billingsley (*Proc. Amer. Soc. hort. Sci.*, 1955, **66**, 7—12).—P and K applications to Elberta peach trees over a 10-year period did not increase the uptake of these elements over that of trees receiving N only. Peach trees on a "per acre basis" remove from the soil elements in the order K (most), N, Ca, P and Mg (least). Peaches remove more K and N and less Ca than do apples. L. G. G. WARNE.

Chemical thinning of fruit trees. R. R. Richards (*Tasmanian J. Agric.*, 1956, **27**, 206—209).—Recommended strengths of naphthylacetic acid for thinning 12 varieties of apple and three varieties of pear are presented. A. H. CORNFIELD.

Foliar sprays of urea on sour cherry trees. D. R. Walker and E. G. Fisher (*Proc. Amer. Soc. hort. Sci.*, 1955, **66**, 21—27).—Urea sprays given to cherries and supplying N equivalent to 0·5 to 1·6 lb. NH_4NO_3 per tree generally increased shoot growth and fruit size but decreased the sol. solids of the fruit. Marginal leaf injury was frequent and due, apparently, to the biuret present in commercial urea. When "crystal urea" was used no leaf injury occurred.
L. G. G. WARNE.

Absorption of fertilizer phosphorus by Navel oranges as influenced by root stock and time of application. W. H. Fuller and R. H. Hilgeman (*Proc. Amer. Soc. hort. Sci.*, 1955, **66**, 31—35).—The use of radioactive liquid H_3PO_4 showed that Navel orange leaves and petioles from trees growing in a clay loam derived a quarter of their total P from the fertilizer applied. The results were the same with rough lemon and sour orange root stocks. Generally older leaves contained less fertilizer P than did young leaves.
L. G. G. WARNE.

Fertilizer injury and its relationship to several previously-described diseases of lettuce. R. G. Grogan and F. W. Zink (*Phytopathology*, 1956, **46**, 416—422).—The disorder described results in wilting and necrosis of leaves (notably outer leaves), discoloration and corking of main roots and death of many lateral roots. Its occurrence is associated with the use of N fertilizers containing or yielding free NH_3 (but not neutral NH_4 salts or nitrates) and with org. manures, e.g., chicken manure, applied close to the roots and producing toxic N compounds, probably NH_3. A. G. POLLARD.

Selection of carrots for carotene content. III. Planting distance and ripening equilibrium of the roots. O. Banga and J. W. de Bruyn (*Euphytica*, 1956, **5**, 87—93).—The carotene content of the roots increases when the roots change shape from a pointed to a stump rooted end as they mature. This change is delayed when the plants are widely spaced. L. G. G. WARNE.

Carotenoids of apricot tomato. J. A. Jenkins and G. MacKinney (*Genetics*, 1955, **40**, 577).—The lycopene content of the fruit of homozygous apricot type is lower (2 to 5 μg. per g.) than in red-fruited types. In this it resembles yellow-fruited types, but differs from them in having a normal β-carotene content.
L. G. G. WARNE.

Soil moisture at pC 2·8 can be vital. S. R. Chaffey (*Grower*, 1956, **45**, 705—707).—The effects on tomato plants of low *p*C values are described. The difference between water régimes of field capacity and wilting point when *p*C value is critical, is emphasized. O. OWEN.

Blotch in tomatoes. R. Dorey (*Grower*, 1956, **45**, 1629—1631).—High concn. of the soil solution effected mainly by the use of K salts completely cleared blotch. Liquid feeding with a solution containing 1% of total solids was used. O. OWEN.

Calcium sulphate and the tomato. D. Hart (*Grower*, 1956, **46**, 34).—$CaSO_4$ is unlikely to be as dangerous to tomato soils as is sometimes suggested. O. OWEN.

How we feed our tomato plants. E. R. Hoare (*Grower*, 1956, **45**, 1509, 1569—1571).—A high yield of tomatoes was produced when all nutrients were applied in solution at an average concn. of 72/100,000 w/w. K was added as KNO_3, P as $NH_4H_2PO_4$, additional N as NH_4NO_3 and Mg as NO_3' or SO_4''. Total amounts used were N 627, P_2O_5 4·5 and K_2O 1254 lb. per acre per annum. O. OWEN.

Problems of nourishing tomatoes. G. F. Sheard (*Grower*, 1955, **44**, 1265—1267; 1956, **45**, 647).—Data quoted show that nutrients are frequently supplied in excess of the crops' requirements. This is particularly true of P; a contributory factor is dung. Nutrients in solution are recommended at dilutions of 1/500 to 1/1000 w/w. Salts which give rise to $CaSO_4$ with hard water are deprecated and the effect on *p*C is discussed. $CaSO_4$ can give up to 30 cwt. of sol. material per acre/foot of soil. O. OWEN.

Are sulphates in the clear for tomatoes? R. E. Butters (*Grower*, 1956, **45**, 767—773).—Where $CaSO_4$ was added to soil to give a *p*C of 2·7 no effect was shown by tomatoes up to the stage when the second truss was flowering. Where the *p*C of 2·7 was produced by addition of NH_4NO_3 considerable damage was caused to the plants. O. OWEN.

Programme for feeding tomatoes. G. C. Procter (*Grower*, 1955, **44**, 1181—1182).—For high yields and good quality fruit N 316, P_2O_5 168 and K_2O 538 lb. per acre per annum are applied in solution during the growth of the crop. In addition, pre-planting treatment consists of 60 tons of dung per acre plus appropriate amounts of N, P, K dependent on soil analysis. The quantities of nutrients necessary are the same irrespective of whether plants are grown in pots or in borders. O. OWEN.

Feeding for quality raises tomato returns. R. E. Butters (*Grower*, **46**, 1956, 1175—1178).—In each of three years addition of nutrients in solution at alternate waterings gave max. tomato yields when compared with no feeding and with feeding at every watering. The highest proportion of first-quality fruit, however, was obtained from plants fed at every watering. Where *p*C values throughout the season were maintained between 3·0 and 3·2 fruit quality was improved without loss of yield. A satisfactory economic compromise is achieved by feeding at alternate waterings. Following a heavy application of $CaSO_4$ in one plot the *p*C value remained at 2·8 throughout the season without ill effects on yield or quality. O. OWEN.

Leaf feeding of determinate tomato plants. II. Effects of urea and sucrose sprays under field conditions. D. A. Shaw and R. J. Hilton (*Canad. J. agric. Sci.*, 1956, **36**, 401—407).—Spraying the plants with urea (0·1—1·0M) increased the sol. N content and lowered the C/N ratio of the leaves. In periods of dull weather and high R.H. urea caused severe leaf-burn: this was partly prevented by addition of sucrose to the spray. Sucrose lowered the rate of absorption of urea by the leaves. Vegetative growth, flowering and fruiting were not significantly affected by the treatment. A. G. POLLARD.

Effect of certain environmental factors on toxicity of manganese in tomato plants grown on steamed soils. M. C. Lutrick (*Dissert. Abstr.*, 1956, **16**, 1311).—Plants grown in steam-sterilized soil exhibit slow growth and chlorotic and necrotic symptoms identical with those of Mn toxicity. Steaming increases the exchangeable Mn but not the availability of other trace elements in soil. Foliar symptoms of Mn toxicity were not apparent under low light intensity, although the same level of Mn injured plants grown under normal light intensity. Sterilization injury was lessened by (*a*) applying P fertilizer, (*b*) increasing the soil temp. and thereby increasing the rate of plant growth and dilution of Mn in the tissues, and (*c*) increasing the soil pH. G. HELMS.

Effect of micro-nutrient deficiencies on nicotine formation by tobacco in water-culture. R. A. Steinberg and R. N. Jeffrey (*Plant Physiol.*, 1956, **31**, 377—382).—The total alkaloid content of the plants was increased by deficiency of B or excess of Mo or Zn, and decreased by deficiency or excess of Cu, Mn or Fe. The total wt. of the plants was lowered by either deficiency or excess of these trace elements. In general the deficiencies were associated with alterations in the proportions of nicotine, nornicotine and anabasine in the plants and also with modifications of root growth. A. G. POLLARD.

Superimposed carbohydrates in the flue-curing of tobacco. I. Effect on chemical changes during flue-curing. II. Effect on yellowing of the leaf during flue-curing and its final quality. A. S. Sastry (*Proc. Indian Acad. Sci.*, 1956, **44B**, 148—161, 162—170).—I. Differences in carbohydrate content in the same leaf were induced by sugar culture and their effects on flue-curing reactions studied. The role of added carbohydrates was similar to that of those *in situ*.

II. Yellowing of leaf cultured on sugar solutions was better than that in controls, owing to the higher carbohydrate content of the sugar-fed leaves. The role of carbohydrates in this process is probably to facilitate the synthesis of N compounds, leading to a more uniform protein and chlorophyll degradation. (27 references.) J. S. C.

Heavy metal content of hop plants in relation to nettlehead. J. R. Hudson (*J. Inst. Brew.*, 1956, **62**, [New Series **53**], 419—424).—A correlation between Ni content of soils and the incidence of nettlehead disease in hops has been found and its significance is discussed. (13 references.) J. S. C.

Mineral nutrition and mycorrhizal association of Bur Oak. K. D. Doak (*Lloydia*, 1955, **18**, 101—108).—*Quercus macrocarpa* was grown in sand culture free from mycorrhizal association. Characteristic N, P and K deficiency symptoms developed when these elements were not supplied. In "humus" cultures the addition of a complete mineral nutrient solution inhibited mycorrhizal development. L. G. G. WARNE.

Evidence for fixation of nitrogen by root nodules of alder (*Alnus*) under field conditions. G. Bond (*New Phytol.*, 1956, **55**, 147—153).—Attached root nodules of alder were enclosed and supplied with free ^{15}N and subsequently shown to contain combined ^{15}N. L. G. G. WARNE.

Growth and formation of organs in *in-vitro* cultures of segments of *Pelargonium zonale* and *Cyclamen persicum*.—L. Mayer (*Planta*, 1956, **47**, 401—446).—The influence of nutritional factors and growth-promoting substances on the propagation of the two species by segmentation are examined. A. G. POLLARD.

Alkaloid yields of *Veratrum fimbriatum* as influenced by site, season and other factors. C. A. Taylor (*Econ. Bot.*, 1956, **10**, 166—173).—The alkaloid content of the roots in early spring is double that in July. Spring-lifted roots that developed top growth but no new roots showed no loss of alkaloid. L. G. G. WARNE.

Pest Control

Recent advances in the development and use of insecticides. C. F. H. Jenkins (*J. Agric. W. Aust.*, 1956, **5**, 181—183).—A general account. A. H. CORNFIELD.

Plant disease forecasting. G. C. Wade (*Tasmanian J. Agric.*, 1956, **27**, 86—88).—A general account. A. H. CORNFIELD.

Hazards in connexion with use of pesticides. H. L. Haller (*Agric. Chemic.*, 1956, **11**, No. 4, 49—50, 128).—Hazards arising during the manufacture, formulation and application of pesticides as well as those of residues on foodstuffs are discussed. A. H. CORNFIELD.

Formulæ for pathographs in phytopathology. K. H. Garren (*Plant Dis. Reptr*, 1956, **40**, 675—680).—The use of pathographs (polygonal graphs for indicating abundance, frequency, maturity and severity of a disease or its host) is discussed and illustrated by application to diseases of annuals and perennials. A. H. CORNFIELD.

Potential plant pathogenic fungi in sewage and polluted water. W. B. Cooke (*Plant Dis Reptr*, 1956, **40**, 681—687).—The occurrence of these organisms in samples of sewage and polluted water is described and discussed in the light of possible infection when these liquids are used for irrigation. A. H. CORNFIELD.

Humidity requirements of foliage pathogens. C. E. Yarwood (*Plant Dis. Reptr*, 1956, **40**, 318—321).—Foliage pathogens are classified into four types on the basis of their requirements for atm. humidity at different stages in their life cycle. A. H. CORNFIELD.

Resistance of insects to insecticides: occurrence and status of insecticide resistant strains. J. R. Busvine (*Chem. & Ind.*, 1956, 1190—1194).—A survey of the literature listing examples of insecticide-resistant strains which have been reported and reviewing field observations, experimental measurements of resistance, the biochemical mechanisms involved and genetical investigations. (54 references.) J. S. C.

Resistance of insects to insecticides: effects of age, stage of development and nutrition. C. Potter (*Chem. & Ind.*, 1956, 1178—

1181).—A review of the literature shows that considerable differences in resistance to insecticides may occur during an insect's life-cycle (e.g., marked instar specificity) and because of differing nutritional conditions. (43 references.) J. S. C.

Insecticide spray accumulations in soil and crop plants. A. C. Foster, V. R. Boswell, R. D. Chisholm, R. H. Carter, G. L. Gilpin, B. B. Pepper, W. S. Anderson and M. Gieger (*U.S. Dept. Agric.*, 1956, Tech. Bull. No. 1149, 36 pp.).—The results of co-operative experiments at Beltsville, Md., State College, Miss., and New Brunswick, N.J., are reported. Aldrin, dieldrin, Isodrin, endrin, heptachlor, chlordane, Dilan, BHC and toxaphene were studied. E. G. BRICKELL.

Structural effect of organic compounds on soil organisms and citrus seedlings grown in an old citrus soil. W. Moje, J. P. Martin and R. C. Baines (*J. agric. Food Chem.*, 1956, **5**, 32—36).—The effects of saturated and unsaturated alcohols, halides, acids, esters, amides and commercial fumigants on the citrus nematode (*Tylenchulus semipenetrans*, Cobb), fungi and bacteria were examined. High toxicity was associated with halides and alcohols containing $\alpha\beta$-unsaturation. Certain halogen derivatives were more effective than commercial fumigants against the nematode; some of the compounds (e.g., sorbic acid, acetylenedicarboxylic acid) stimulated the development of *Trichoderma viride*. Since *T. viride* is antagonistic to pathogenic fungi (*Phytophthora*, *Pythium*, etc.), a possibility of indirect biological control is indicated. (26 references.) E. M. J.

Host nutrition and attack by fungal parasites. J. Granger (*Phytopathology*, 1956, **46**, 445—456).—Susceptibility to infection ("disease potential") of potato to *Phytophthora* blight was low at times of rapid growth or of low carbohydrate content in the tissues. Relationships between disease potential, and the combined effects of growth rate and carbohydrate content are examined. A. G. POLLARD.

Evaluation of extent of emulsification of pesticide sprays containing aromatic petroleum solvents. M. J. Janis (*Agric. Chemic.*, 1956, **11**, No. 10, 42—44, 127—128).—Two methods of assessing the degree of emulsification are described. One is based on the physical appearance of the emulsion and the other on the extent of phytotoxicity which arises when young bean plants are treated with the materials. A. H. CORNFIELD.

Antifungal properties of tetrazolium compounds. A. Shatz, V. Shatz and G. S. Trelawney (*Mycologia*, 1956, **48**, 473—483).—Seven fungi pathogenic and four not pathogenic to man were tested. Three of the 16 tetrazolium compounds tried were antifungal and they inhibited the growth of the pathogenic more than the growth of the non-pathogenic fungi, suggesting their possible value for the treatment of dermatophytic infections. L. G. G. WARNE.

Effect of methyl bromide on respiration of the cadelle *Tenebroides mauritanicus* (L.) (Coleoptera: Ostomidæ). E. J. Bond (*Canad. J. Zool.*, 1956, **34**, 405—415).—The susceptibility of individual cadelles to MeBr is correlated with their characteristic rates of O_2 consumption. The cadelle does not exhibit "protective stupefaction," thus differing from the granary weevil and certain scale insects. It differs, also, from *Tribolium*, *Sitophilus* and *Musca* in being paralysed during fumigation by MeBr. (25 references.) J. S. C.

Mechanism of reaction of di-*n*-propyl 2:2-dichlorovinyl phosphate (DDP) with esterases. B. J. Jandore (*J. agric. Food Chem.*, 1956, **4**, 853—858).—DDP is compared with phosphofluoridates in respect of spontaneous hydrolysis, reaction with accelerators of hydrolysis and interaction with esterases leading to enzymic inactivation. DDP is an active anti-esterase, its rate of reaction being comparable with that of di-*iso*propyl phosphorofluoridate. It is very stable towards hydrolysis and does not react with catechol or a hydroxamic acid. The mechanism of its reactions with enzymes is discussed. (33 references.) N. M. WALLER.

Use of granulated zinc columns for determining chlorinated organic insecticides. I. Hornstein (*J. agric. Food Chem.*, 1957, **5**, 37—39).—A procedure is described for the partial or complete removal of the organically bound Cl in chlorinated org. insecticides as chloride ion, by percolation of an acidified solution through a granulated Zn column. The fraction removed as chloride ion is a function of the mol. structure of the compound, and is a reproducible value for a given insecticide; it is determined by potentiometric titration with $AgNO_3$. E. M. J.

Determination of mercury in fungicidal preparations containing organo-mercury compounds. I. Determination of organo-mercury compounds by direct titration. II. Determination after decomposition to mercuric sulphide. K. F. Sporek (*Analyst*, 1956, **81**, 474—477, 478—482).—I. Analytical procedures for determining Hg in org. Hg compounds are described. In the absence of halide ions many of these compounds can be titrated with standard NH_4CNS with $Fe^{\cdots}$ alum as indicator. The factor is double that used in inorg. titrations (1 ml. 0·1N ≡ 0·02006 g. of Hg). In a non-aq. titration method described the compound is dissolved in chloroform–propylene glycol and is titrated with standard HCl, the indicator being ethanolic thymol blue. A third method is based on a direct titration in aq. acetone with standard $HClO_4$ after liberation of the hydroxyl ion by treatment of the Hg compound with KI. Of the three methods only the last is applicable to the determination of org. Hg chlorides.

II. The method described depends upon the formation of water-sol. complexes of certain org. Hg compounds with Na_2S. The compound is extracted with conc. Na_2S solution. The extract is then boiled with dil. H_2SO_4 under reflux and the pptd. HgS is collected, oxidized and the Hg content is determined by titration with standard NH_4CNS with $Fe^{\cdots}$ alum as indicator. Two procedures are described, one applicable to materials containing org. Hg compounds in water-sol. diluents and the other suitable for materials containing diluents insol. in water and containing org. insecticides, dyes, pigments, etc. A. O. JONES.

Colorimetric method for determining 2:4-dichloro-6-(*o*-chloroanilino)-*s*-triazine and related compounds. H. P. Burchfield and E. E. Storrs (*Contr. Boyce Thompson Inst.*, 1956, **18**, 319—330).—*s*-Triazine derivatives with active halogen atoms substituted in the heterocyclic ring will react with aq. or anhyd. pyridine to give water-sol. compounds that become intensely yellow in the presence of alkali. Glycine enhances the colour. An aq. solution of the triazine, either in the presence or absence of phosphate buffer at pH 7·0 (which represses the colour intensity) is treated with a 70% aq. solution of pyridine saturated with glycine and filtered. After 20 min. 7N-NaOH is added and the solution transferred to a 1-cm. cell. Absorbance measurements are made at 440 mμ. against a standard reagent blank and the value at 2 min. after the addition of alkali interpolated. Interference from coloured pigments extracted from green plants and fungus spores can be eliminated almost completely by carrying out the reaction in anhyd. pyridine, diluting with light petroleum and extracting with water. E. G. BRICKELL.

A mucous mould fungus *Acrostalagmus roseus*, Banier, as antagonist to some plant pathogens. O. Pohjakallio, A. Salonen, A.-L. Ruokola and K. Ikäheimo (*Acta agric. scand.*, 1956, **6**, 178—194).—The fungus is capable of growth in soil, in tomato fruits and in clover. It has an antibiotic action on a considerable range of phytopathogenic fungi, details of which are recorded. A. G. POLLARD.

Susceptibility of some vegetables to streptomycin injury. R. B. Marlatt (*Agric. Chemic.*, 1956, **11**, No. 5, 72—73, 127).—Greenhouse tests with 14 species of vegetables showed that there was no visible injury, except with potato and radish where slight chlorosis occurred, when 0·1% streptomycin sulphate spray was applied to the leaves. Slight to moderate chlorosis occurred on seven of the species after a 1% spray and slight to severe chlorosis on 11 of the species after a 4% spray. A. H. CORNFIELD.

Availability of streptomycin in dust formulations. P. A. Ark and E. M. Wilson (*Plant Dis. Reptr*, 1956, **40**, 332—334).—Pyrophyllite, $Ca(OH)_2$, S, $CaCO_3$ and $MgCO_3$ were excellent carriers of streptomycin, in that the antibiotic was released readily on mixing with water. Fuller's earth, talc, frinite, attaclay, and Taco clay bound streptomycin so as to render it unavailable on mixing with water. Both pyrophyllite– and $Ca(OH)_2$–streptomycin formulations (1000 p.p.m. streptomycin) gave good control of angular leaf spot, *Pseudomonas lachrymas*, of cucumbers. A. H. CORNFIELD.

Control of snow mould, *Typhula* spp. and *Fusarium nivale*, of winter wheat in Eastern Washington, 1955—56. R. Sprague (*Plant Dis. Reptr*, 1956, **40**, 640—642).—Of materials tested as sprays on newly-emerged winter wheat only Ceresan M2X (2·5 lb.) and Mema (2·5 pints per acre) were effective in controlling snow mould and giving reasonable survival of wheat stands in the following spring. A. H. CORNFIELD.

Control of powdery mildew, *Erysiphe graminis tritici*, of wheat. W. Crosier and M. Szkolnik (*Plant Dis. Reptr*, 1956, **40**, 337—339).—Powdery mildew of wheat was controlled with micronized S (3—6 lb.) or Karathane (1 lb. per 100 gal.) but was reduced only slightly by actidione (2—3 p.p.m.). Actidione (3 p.p.m.) caused a marginal discoloration and necrosis of wheat leaves. A. H. CORNFIELD.

Effectiveness of seed treatment materials when applied to oats with a commercial treating machine. D. C. Arny (*Plant Dis. Reptr*, 1956, **40**, 364—366).—Oats treated with org. Hg seed disinfectants by means of a slurry treater gave yields and showed reduction in seedling blight equal to those obtained by laboratory treatment. Du Pont 365 compared less favourably with the standard treatments, Ceresan M and Panogen, under machine than under laboratory treatment. A. H. CORNFIELD.

Seed treatment tests on winter oats and wheat, 1955—56. R. W. Leukel and R. W. Earhart (*Plant Dis. Reptr, 1956,* **40,** *785—787*).—Results obtained with a large variety of seed disinfectants are reported. A. H. CORNFIELD.

New disease of maize caused by *Curvularia maculans*. R. R. Nelson (*Plant Dis. Reptr*, 1956, **40,** 210—211).—Symptoms of this disease of the maize leaf, which was traced to *C. maculans*, are described. This is the first known report of *C. maculans* behaving as a plant pathogen. A. H. CORNFIELD.

Control of maize diseases during 1954—55. G. W. Herd (*Rhod. agric. J.*, 1956, **53,** 525—537).—Incidence of *Helminthosporium turcicum* and *Puccinia polysora* were considerably reduced and yields of maize were increased by spraying with zineb (2 lb. per 100 gal.) every week from when plants were 18 in. high to the grain-hardening stage. There were varietal differences in resistance to both organisms. Rust due to *Pucc. polysora* appeared earlier and was more severe at low than at high altitudes. A. H. CORNFIELD.

Control of late blight of potatoes. P. G. Williams, G. C. Wade and E. G. Cartledge (*Tasmanian J. Agric.*, 1956, **27,** 229—235).—All of the eight fungicides tested greatly increased yields of tubers through control of late blight. Plots sprayed weekly gave higher yields than did those sprayed every 2 weeks. Manzate (1·5 lb.), zineb (2·25 lb. per acre), Bordeaux mixture (4 : 2 : 40), and 8% " Copper Dust " were somewhat more effective than were the other materials. A. H. CORNFIELD.

Control of potato scab with Vapam and pentachloronitrobenzene. H. C. Fink (*Agric. Chemic.*, 1956, **11,** No. 5, 72—73).—Both 31% Vapam (Na *N*-methyldithiocarbamate dihydrate) and 75% pentachlorobenzene (25—100 lb. per acre) applied to the soil two weeks prior to sowing reduced the incidence of scab in potatoes. Vapam was somewhat the more effective. A. H. CORNFIELD.

Control of bacterial and fungal decay of potato seed pieces. J. F. Malcolmson and R. Bonde (*Plant Dis. Reptr*, 1956, **40,** 708—713).—Good control of fungal decay of seed pieces, which was stimulated by treatment with streptomycin, was obtained by treating the pieces with Dithane, Phygon or captan before cutting. Antibiotics were not effective against both bacterial and fungal rots. Good control of fungal rots was obtained by treatment with rimocidin sulphate (100 p.p.m.). A. H. CORNFIELD.

Control of bacterial and fungal decay of potato seed pieces with antibiotics. R. Bonde and J. F. Malcolmson (*Plant Dis. Reptr*, 1956, **40,** 615—619).—Of a number of antibiotics tested Terramycin hydrochloride and streptomycin sulphate or nitrate (each 100 p.p.m.), were effective in preventing bacterial rot of potato seed pieces and increasing stands. Magnamycin and Malucidin (50—100 p.p.m.) were partially effective. The streptomycin treatments enhanced the growth of *Fusarium* and *Phoma* rots. A. H. CORNFIELD.

Effect of malachite green on potato viruses X and Y. A. D. Thomson (*Aust. J. agric. Res.*, 1956, **7,** 428—434).—The effect of malachite green on potato viruses X and Y was studied, using potato shoot apices in tissue culture. No plants were freed from either virus and there was no significant effect of the dye on virus X concn. When the dye was sprayed on leaf surfaces or watered on the soil it had no effect on the systemic spread of a ringspot isolate of virus X. (14 references.) R. H. HURST.

Nitrogen metabolism of leaf-roll potato plants. O. Henke (*Zbl. Bakt.*, 1956, **109, II,** 367—388).—Changes in the nature and proportions of N compounds in leaves and tubers at different stages of growth are examined. A. G. POLLARD.

Control of early maturity disease of potatoes by soil treatment with Vapam. R. A. Young (*Plant Dis. Reptr*, 1956, **40,** 781—784).—Early maturity disease (early dying disease, attributed to *Verticillium albo-atrum*) of potatoes was controlled by applying Vapam 190 lb. per acre to a depth of 6 in. 10 days prior to planting. Pentachloronitrobenzene (100 lb. per acre) was ineffective. Both materials markedly reduced weed incidence. A. H. CORNFIELD.

Persistence of the golden nematode, *Heterodera rostochiensis*, Wollenweber, in a field treated with dichloropropane-dichloropropene (D-D). J. F. Spears, W. F. Mai and D. O. Betz (*Plant Dis. Reptr*, 1956, **40,** 632—634).—The % of viable cysts of *H. rostochiensis* were reduced by about 35% by application of D-D in 1946. From 1946 to 1955 (during which period neither potatoes nor other host plants were grown) the % of viable cysts fell gradually to zero. A. H. CORNFIELD.

Spotted lucerne aphid, *Therioaphis maculata*. R. W. Harper (*Agric. Chemic.*, 1956, **11,** No. 6, 44—45, 133).—The depredations of the spotted lucerne aphis since its first appearance in the U.S. in 1954 and methods of chemical control are discussed. Thorough control is difficult because of the high reproductive capacity and *mobile habits of the pest. Native predators have given effective control in some areas. The lucerne variety Lahontan is highly* resistant to attacks by the aphid. A. H. CORNFIELD.

Control of the pasture cockchafer, *Aphodius pseudotasmaniæ*. E. J. Martyn (*Tasmanian J. Agric.*, 1956, **27,** 44—49).—The pasture cockchafer was controlled by application of γ-$C_6H_6Cl_6$ (4 oz.) or aldrin (6·6—8 oz. per acre) as low vol. sprays. A. H. CORNFIELD.

Effect of method of inoculation on control of head smut, *Ustilago bullata*, of mountain brome by seed treatment. J. P. Meiners (*Plant Dis. Reptr*, 1956, **40,** 734—736).—Arasan SF-X (4 oz.), Ceresan-M (1 oz.) and Agrox (1 oz. per bushel of seed) gave excellent control of the smut when naturally infected seed was treated. When heavily-infected (partial-vac. inoculated) seed was treated only Ceresan-M was effective in controlling head smut. A. H. CORNFIELD.

The clover leaf weevil. Anon. (*U.S. Dep. Agric.*, 1956, Fmrs Bull. No. 1484, 6 pp.).—Excessive larvæ can be controlled by methoxychlor (1 lb. per acre) but normally the pest is kept within bounds by the fungus *Empusa sphærosperma* development of which is favoured by keeping the humus content of the soil at a level favourable for the conservation of water, thus insuring a vigorous crop, and by using clover or lucerne regularly with grass in crop rotation. E. G. BRICKELL.

Apple bitter rot. J. C. Dunegan (*U.S. Dep. Agric.*, 1956, Leafl. No. 406. 2 pp.).—The disease, which is fungus-produced, is described. Ferbam and captan at 2 lb. per 100 gal. give control; Dichlone at 0·75—1 lb. per 100 gal. is also effective. E. G. BRICKELL.

Influence of fungicide and fruit maturity on development of ripe spot and target rot of apples. G. C. Wade and J. R. Ward (*J. Aust. Inst. agric. Sci.*, 1956, **22,** 198—203).—Field trials showed that thiram or captan, applied early in the season, gave efficient control of ripe spot on apple trees but that control of ripe spot and target rot of fruit in storage is not achieved unless the applications are continued until much later in the season. J. S. C.

Effects of nitrogen nutrition on growth and sporulation of *Alternaria tenuis*, strain B, causing core rot of apples. J. S. Grewal (*Lloydia*, 1955, **18,** 74—81).—No growth of the fungus occurred in the absence of a N supply. The effect of 28 N compounds on growth was tested. Best growth was obtained with $Mg(NO_3)_2$, $Ca(NO_3)_2$, NH_4 oxalate, NH_4 acetate, peptone, D-alanine, L-phenylalanine, glycine and acetamide. Other amino-acids were intermediate (although leucine and histidine were poor) but NH_4NO_3, NH_4 tartrate, NH_4Cl, $(NH_4)H_2PO_4$, $NaNO_3$, NH_4Br and $(NH_4)_2SO_4$ were poor sources of N. No growth occurred with $NaNO_2$ or KNO_2 as N source. L. G. G. WARNE.

Control of Armillara root rot, *Armillaria mellea*, of fruit trees. Anon. (*Agric. Gaz. N.S.W.*, 1956, **67,** 94—97).—Diseased bark and roots are cut out and the surfaces treated with Bordeaux paint ($CuSO_4$,$5H_2O$ 1·5 lb., $Ca(OH)_2$ 1I5 lb., water 2 gal.). Temporary exposure of roots to drying conditions by removal of soil quickly kills the disease. A. H. CORNFIELD.

Control of the Mediterranean fruit fly. Anon. (*Agric. Chemic.*, 1956, **11,** No. 9, 48—49, 135).—A general account of the measures for control now being adopted in Florida. A. H. CORNFIELD.

Control of crown gall. Anon. (*Agric. Gaz. N.S.W*, 1956, **67,** 199—200).—Crown gall, due to *Agrobacterium tumefaciens*, of fruit trees, especially stone fruit trees, is controlled by removing the gall and painting the galled area with 20% Dinoc in methylated spirits. A. H. CORNFIELD.

Control of brown rot, *Sclerotinia fructiola*, of stone fruit. G. C. Wade (*Tasmanian J. Agric.*, 1956, **27,** 122—125).—The best control of brown rot of stone fruit was obtained by spraying with thiram at full bloom, petal fall, and shuck fall and as cover sprays when ripening commenced. Brown rot was less extensive on apricot trees of high than on those of low K status. Application of 2 lb. of KCl per tree reduced brown rot from 29·8 to 11·1%. A. H. CORNFIELD.

Control of peach root knot with Nemagon (1 : 2-dibromo-3-chloropropane). H. H. Foster and L. W. Baxter (*Plant Dis. Reptr*, 1956, **40,** 400—402).—Application of Nemagon (5—8 gal. per acre injected to 12 in.) gave satisfactory control of peach root knot accompanied by improved shoot growth. Heavier application of the chemical produced phytotoxic effects. A. H. CORNFIELD.

Control of bacterial spot, *Xanthomonas pruni*, of peach. R. H. Daines (*Plant. Dis. Reptr*, 1956, **40,** 335—336).—Bacterial spot of peach was controlled by spraying the trees every 7—10 days with captan (4 lb. per 100 gal.) or with captan (2 lb.) + streptomycin (150 p.p.m.). S (5 lb.) and captan (2—3 lb.) were relatively ineffective. A. H. CORNFIELD.

Dry stem of Valencia oranges. Anon. (*Agric. Gaz. N.S.W.*, 1956, **67,** 257—258).—This condition occurs in trees which are not able to

maintain an adequate water supply to the mature fruit. In humid areas the melanose fungus (*Diaporthe citri*) often becomes established on dead fruit stalks. The trouble is prevented by adequate watering. Trees should not be allowed to carry a heavy crop if they are likely to be subjected to acute water shortage. Application of 2 : 4-D (22 p.p.m.) spray in late winter is recommended. A. H. CORNFIELD.

Control of citrus orchard butterflies. E. H. Zeck (*Agric. Gaz. N.S.W.*, 1956, **67,** 260—261).—The caterpillars of *Papilio ægeus* and *P. anactus* were controlled by spraying with 0·05% DDT. A. H. CORNFIELD.

Control of insect pests of dried fruit. E. H. Zeck (*Agric. Gaz. N.S.W.*, 1956, **67,** 34—38).—Ten insect species found commonly on dried fruit and their control by fumigation with CS_2 or ethyl formate are described. A. H. CORNFIELD.

Nematodes in strawberry soils and their control. N. L. Horn, W. J. Martin, W. F. Wilson, jun. and M. J. Giamalra (*Plant Dis. Reptr*, 1956, **40,** 790—797).—In the soil around strawberry roots in the commercial strawberry growing areas of Louisiana 25 genera of nematodes were found. The numbers of nematodes were greatly reduced by treating the soils with ethylene dibromide (2—4 gal. per acre). Yields of plants were significantly higher where *Meloidogyne hapla*, but not where some other genera, were reduced by the treatment. A. H. CORNFIELD.

Control of root-knot nematodes of strawberries with 1 : 2-dibromo-3-chloropropane (Nemagon). H. S. Potter and O. D. Morgan (*Plan Dis. Reptr*, 1956, **40,** 187—189).—Soil application of Nemagon (0·4—0·8 gal. of actual material in 5% solution, or 140—280 lb. per acre as 5% Nemagon on Attaclay) at the time when plants were side-dressed with fertilizer gave good control of root rot, *Meloidogyne hapla*, of strawberries without any phytotoxic effects. A. H. CORNFIELD.

Control of grey mould *Botrytis cinerea*, of strawberries. P. M. Miller and E. M. Stoddard (*Plant Dis. Reptr*, 1956, **40,** 788—789).—Thylate (thiram, 3 lb.) and Phygon XL (0·375 lb. per 100 gal.) sprayed at the start of blooming and again 18 and 28 days later gave better control of grey mould than did captan (6 lb. per 100 gal.). A. H. CORNFIELD.

Control of black-root-rot of strawberries. D. J. Raski (*Plant Dis. Reptr*, 1956, **40,** 690—693).—In pot tests chloropicrin (0·5 ml. per gal. of soil) was the most effective fumigation treatment for increasing the growth of strawberry plants. Dichloropropane-dichloropropene (0·25 ml. per gal.) was somewhat less, whilst Dowfume W-40 was much less, effective. *Pratylenchus penetrans* was of less importance than were other organisms in inducing black-root-rot. A. H. CORNFIELD.

Diseases of lucerne, chou moellier, field turnips, and rape and their control. Anon. (*Tasmanian J. Agric.*, 1956, **27,** 17—23).—The diseases and methods of control are described. A. H. CORNFIELD.

Control of downy mildew of onions. R. F. Doepel (*J. Agric. W. Aust.*, 1956, **5,** 185—190).—Application of zineb (1·5 lb. per 100 gal.) commencing before mildew started and then every 10—14 days throughout the season reduced the incidence of downy mildew and increased the yields of onions. $CuOCl_2$ (3·3 lb. per 100 gal.) sprays were ineffective. A. H. CORNFIELD.

Pink rib of head lettuce. R. B. Marlatt and J. K. Stewart (*Plant Dis. Reptr*, 1956, **40,** 742—743).—An abnormality of field lettuce consisting of a diffuse pink coloration of the main leaf ribs and occasionally of the smaller veins is reported from Arizona. Pink rib also developed during storage of apparently normal lettuce heads. The extent of the symptoms decreased with temp. of storage, and was not related to extent of fungal or bacterial decay arising during storage. A. H. CORNFIELD.

Fungicide and insecticide seed treatment of peas and beans, 1953—55. D. J. deZeeuw, G. E. Guyler and A. L. Anderson (*Plant Dis. Reptr*, 1956, **40,** 727—733).—Results of seed treatment tests over three years with fungicides, insecticides, and combinations of the two on beans and peas are reported. Most materials containing captan, thiram or Dichlone were effective in increasing stands of healthy seedlings, whilst Hg compounds were generally not quite as effective. Insecticide treatment of seed was generally beneficial to beans, but usually slightly harmful to peas. A. H. CORNFIELD.

Control of downy mildew, *Phytophthora phaseoli*, of lima beans with streptomycin. W. J. Zaumeyer and R. E. Webster (*Plant Dis. Reptr*, 1956, **40,** 776—780).—Application of 100 p.p.m. streptomycin sprays (various formulations) or 1000 p.p.m. dusts gave excellent control of downy mildew of lima beans. A. H. CORNFIELD.

Localized systemic activity of griseofulvin in the control of *Alternaria* blight of tomato. D. Davis and J. W. Rothrock (*Plant Dis. Reptr*, 1956, **40,** 328—329).—Incidence of *Alternaria solani*, inoculated on to either the upper or lower leaf surface, was considerably reduced when griseofulvin (125—1000 p.p.m.) was sprayed on the opposite side of the leaf. The antibiotic was active in reducing the infection even when inoculation was practised seven days after treatment. A. H. CORNFIELD.

Influence of overhead irrigation on the incidence and control of tomato diseases. D. F. Crossan and P. J. Lloyd (*Plant Dis. Reptr*, 1956, **40,** 314—317).—Tomatoes on overhead-irrigated plots showed significantly higher incidence of anthracnose and fruit rot, due to *Rhizoctonia solani*, and lower incidence of blossom-end rot than did plants on non-irrigated plots. Maneb and zineb (2 lb. per 100 gal.) controlled anthracnose under both irrigated and non-irrigated conditions, but maneb was more satisfactory under irrigation. Both materials reduced blossom-end rot in non-irrigated plots, whilst neither controlled fruit rot. A. H. CORNFIELD.

Grey mould, *Botrytis cinerea*, of tomatoes in South Florida. R. S. Cox and N. C. Hayslip (*Plant Dis. Reptr*, 1956, **40,** 718—726).—Dichlone, ferbam, Vancide 51, Tennam and thiram effectively controlled grey mould of tomato foliage. Repeated spraying with nabam + metal salts resulted in increased incidence of the disease. Dichlone overcame this effect when applied with nabam–$ZnSO_4$, but phytotoxicity was increased. Dichlone caused injury when applied on hot days. Tennam caused slight, and Vancide 51 moderate, foliage injury. A. H. CORNFIELD.

Reduction of internal cork of sweet potatoes by application of insecticides. E. J. Kantack and W. J. Martin (*Plant Dis. Reptr*, 1956, **40,** 410).—Both the incidence and severity of internal cork lesions of sweet-potato roots were reduced by application of 10% DDT dust + a systemic insecticide (American Cyanamid Compound 12008). A. H. CORNFIELD.

Control of bacterial spot, *Xanthomonas vesicatoria*, (Doidge) Dows, of pepper. R. S. Cox (*Plant Dis. Reptr*, 1956, **40,** 205—209).—Of a number of materials tested only a 200—1000 p.p.m. prep. of streptomycin and " tribasic $CuSO_4$ " (2—4 lb. per 100 gal.) gave effective control of bacterial spot of pepper and also resulted in increased yields. When both materials were applied together control was somewhat better than when either was applied separately. A. H. CORNFIELD.

Control of mushroom mould, *Dactylium dendroides*, and lipstick mould, *Geotrichum* sp. on mushroom beds. R. N. Goodman (*Plant Dis. Reptr*, 1956, **40,** 714—717).—Actidione (cycloheximide) (2·6), anisomycin (100) and Dowcide A (*o*-phenylphenol, Na salt) (500—1000 p.p.m.) prevented the development of mushroom mould for only 10 days after treatment. Griseofulvin (100 p.p.m.), rimocidin and oligomycin were ineffective. Terraclor (pentachloronitrobenzene) (500—1000 p.p.m.) virtually prevented growth of the organism for six weeks and also controlled lipstick mould. A. H. CORNFIELD.

Control of mildew disease, *Dactylium dendroides*, of mushroom. B. B. Stoller, R. E. West and J. F. Bailey (*Plant Dis. Reptr*, 1956, **40,** 193—199).—Of 32 materials tested in the laboratory Terraclor (pentachloronitrobenzene) was the most satisfactory for controlling *Dactylium* mildew. Dithiocarbamates and plant growth substances were relatively ineffective, whilst antibiotics were ineffective when applied at an economic level. Many other materials in general use as mushroom disinfectants were relatively ineffective against this mildew. A. H. CORNFIELD.

Control of wildfire, *Pseudomonas tabaci*, in tobacco plant beds. L. Shaw and G. W. Thorne (*Plant Dis. Reptr*, 1956, **40,** 325—327).—Application of 200-p.p.m. streptomycin sprays or 1000—4000-p.p.m. dusts four times at weekly intervals gave good control of wildfire on tobacco plants. Terramycin (200—400 p.p.m.), Bordeaux mixture (3–4–50) and " tribasic $CuSO_4$ " (3 lb. per 100 gal.) were much less effective. A. H. CORNFIELD.

Control of wildfire, *Pseudomonas tabaci*, in tobacco plant beds with streptomycin. G. N. Rhodes, R. P. Mullet and J. N. Matthews (*Plant Dis. Reptr*, 1956, **40,** 202—204).—As a preventative control of wildfire on tobacco a 100-p.p.m. streptomycin spray was superior to the standard " Tribasic $CuSO_4$ " drench. A 200-p.p.m. streptomycin spray eradicated all visible active wildfire on plants which had become naturally infected. A 0·2% dust was not quite as effective. A. H. CORNFIELD.

Pectic enzymes of *Phytophthora parasitica* var. *nicotianæ*, the cause of black shank of tobacco. A Husain and A. Kelman (*Plant Dis. Reptr*, 1956, **40,** 629—631).—Pectin-methyl-esterase could not be detected in liquid culture filtrates of *P. parasiticæ*. Culture filtrates contained a polygalacturonase that caused a rapid loss in viscosity of a 1·2% Na polypectate solution. A. H. CORNFIELD.

Diseases of hops in Tasmania. E. G. Cartledge (*Tasmanian J. Agric.*, 1956, **27,** 210—218).—Diseases and methods of control are described. A. H. CORNFIELD.

Fundamental concepts in the development of control measures for southern blight and root-rot on groundnuts. L. W. Boyle (*Plant Dis. Reptr*, 1956, **40**, 661—665).—The distinction between necrotrophic (dead-food) and biotrophic (living-food) parasites is reviewed and the practical applications in the development of control measures for diseases of groundnuts are discussed. A. H. CORNFIELD.

Influence of actidione on wood-staining fungi. C. L. Fergus (*Mycologia*, 1956, **48**, 468—472).—Actidione had only a slight effect on the growth of most of the wood-staining fungi tested (in culture). Within the genus *Ophiostoma* great variation was found in tolerance to actidione. L. G. G. WARNE.

Secondary leaf fall [in rubber trees]. Anon. (*R.R.I. Plant Bull.*, 1956, 105—109).—The fungi *Oidium heveæ* and *Glœosporium alborubrum*, the mite *Hemitarsonemus latus*, and the thrips *Scirtothrips dorsalis* which, either alone or in combination, contribute to the loss of immature leaf, are described. Clonal differences in the time of wintering may influence the susceptibility of plants to attack. In Ceylon the severity of *Oidium* attack is combated by routine S dusting during the refoliation period. E. G. BRICKELL.

Phytotoxic effects of fungicides against poplar shoots. J. Chardenon and B. Taris (*C. R. Acad. Agric. Fr.*, 1956, **42**, 709—713; cf. J.S.F.A. Abstr., 1957, i, 11).—In *in vitro* tests with dinitrobutylphenol (DNBP) a concn. of 25 μg. per c.c. was effective against *Dothichiza populea*, Sacc. et Briard, and against *Cytospora chrysosperma*, (Pers.) Fr. When poplar shoots were treated with DNBP (5%), nearly all developed; roots appeared only at 2 or 3 cm. from the base of the shoot; this was not scarred by a callus, but was necrotic in most cases. Similar results were obtained with dinitro-*o*-cresol and emulsified anthracene oils (5%). Cu compounds had no notable phytotoxic effect. E. M. J.

Powder-post and other wood borer beetle pests of timber in Rhodesia. D. J. W. Rose (*Rhod. agric. J.*, 1956, **53**, 218—234).—The pests, methods of protecting wood against them, and curative measures are described. A. H. CORNFIELD.

Control of the corbie, *Oncopera intricita*, Walker. E. J. Martyn (*Tasmanian J. Agric.*, 1956, **27**, 287—190).—The corbie was controlled by DDT (8—16 oz. per acre), better control being obtained when application was made in Aug. than in Sept. Aldrin and dieldrin (1 lb. per acre) were ineffective. A. H. CORNFIELD.

Control of the passion vine hopper, *Scolypopa australis*. E. H. Zeck (*Agric. Gaz. N.S.W.*, 1956, **67**, 98).—The passion vine hopper is controlled in the immature stage by spraying with nicotine (nicotine sulphate 1 + white oil emulsion 8 fl. oz. per 4 gal.) or 0·1% DDT spray. A. H. CORNFIELD.

Control of pests on ornamentals with systemic insecticides. B. W. Arthur (*Agric. Chemic.*, 1956, **11**, No. 6, 79).—Of six systemic insecticides tested demeton (Systox) and Compound 21/116 (related to Systox) applied twice with a 30-day interval were the most effective and controlled tea and camellia scale, azalea lace bugs, whiteflies and thrips. Soil applications were as effective as were foliage applications. A. H. CORNFIELD.

Control of foliar nematode disease, *Aphelenchoides olesistus*, of ferns and begonias. Anon. (*Agric. Gaz. N.S.W.*, 1956, **67**, 258—259).—This nematode disease was controlled in ferns by spraying the foliage with E605 or parathion (1 oz. 50% emulsion per 50 gal.) at 3-weekly intervals or by drenching the soil with Systox (1 fl. oz. 50% emulsion per 4 gal.). E605 was ineffective, whilst Systox soil drench was effective, in controlling the disease in begonias. A. H. CORNFIELD.

Control of cutworms, Noctuidæ. E. H. Zeck (*Agric. Gaz. N.S.W.*, 1956, **67**, 263).—Cutworms were controlled with baits made from Paris green or Paris green + DDT or $C_6H_6Cl_6$. A. H. CORNFIELD.

Resistance of locusts to DNC in relation to their weight, age and sex. R. D. MacCuiag (*Ann. appl. Biol.*, 1956, **44**, 634—642).—Resistance of adults of the desert locust and the African migratory locust to DNC applied as a contact poison to the ventral surface of the abdomen was directly related to body wt. irrespective of age (fledging to maturity) or sex. Variation in the site of application of the insecticide had relatively little effect on kills obtained, except that kills were somewhat lower when applications were made to wings or femur. Final mortality of treated insects was similar whether they were kept at 25° or 36°, although rate of kill was more rapid at the higher temp. A. H. CORNFIELD.

Control of the field cricket *Acheta commodus*. E. H. Zeck (*Agric. Gaz. N.S.W.*, 1956, **67**, 262).—The field cricket was controlled by use of baits made from DDT, chlordane or γ-$C_6H_6Cl_6$. A. H. CORNFIELD.

Control of the Argentine ant. P. N. Forte and T. Greaves (*J. Agric. W. Aust.*, 1956, **5**, 85—86).—Excellent control of Argentine ants on household allotments was obtained with 0·375—0·500% dieldrin sprays (70 gal. per acre) even 62 weeks after treatment. Chlordane (2%) sprays also gave good and persistent control. Aldrin (0·5—1·0%) gave moderate control but 2% DDT was ineffective. A. H. CORNFIELD.

Control of the red-legged earth mite, *Halotydeus destructor*, Tucker, and the lucerne flea, *Smynthurus viridis* L. C. F. H. Jenkins (*J. Agric. W. Aust.*, 1956, **5**, 171—179).—Both pests were controlled in pastures by spraying with malathion (0·5 oz.) + DDT (1 oz. per acre). The red-legged mite was controlled with DDT (4 oz. per acre), which was ineffective against the lucerne flea. $C_6H_6Cl_6$ (1·1—2·3 oz. per acre) did not control the lucerne flea but gave moderate control of the earth mite. Dieldrin (4—8 oz. per acre) was ineffective against the earth mite but gave fair control of the lucerne flea. A. H. CORNFIELD.

Rabbit poisoning with 1080 (sodium fluoroacetate). A. R. Tomlinson, C. E. Marshall and C. D. Gooding (*J. Agric. W. Aust.*, 1956, **5**, 5—15).—Oats was the most effective bait for use with 1080. The importance of proper placement of the bait in relation to rabbit movement is stressed. 1080 was far superior to any other poison tested. Secondary poisonings have been few; foxes were most seriously affected, particularly where apple was used as bait. A. H. CORNFIELD.

Effect, on oyster spatfall, of controlling barnacles with DDT. G. D. Waugh and A. Ansell (*Ann. appl. Biol.*, 1956, **44**, 619—625).—Control of barnacles on artificial collectors (by spraying with DDT, 0·00003 g. per sq. cm.) doubled the yield of oyster spat and increased the average diam. of spat by 40%. The treatment inhibited the initial growth of spat. A. H. CORNFIELD.

EPTC [herbicide]. Anon. (*Farm Chemicals*, 1957, **120**, No. 2, 44—47).—Successful preliminary trials with Et *NN*-di-*n*-propylthiocarbamate [EPTC] in the pre- or post-emergence control of a no. of weeds in different crops are recorded. Effective results are shown under a wide range of soil moisture (even if very low), rainfall and temp. (60—102°F.). A. G. POLLARD.

Plant-growth activity of phenoxythioacetic acids. H. Burström, B. Sjöberg and B. A. M. Hansen (*Acta agric. scand.*, 1956, **6**, 155—177).—Comparison is made of the herbicidal effects of 2-methyl-6-chloro-, 2 : 4-dichloro- and 2 : 4 : 5-trichloro-phenoxyacetic acids, and of their thio-analogues (prep. and properties described). Although no generalizations were possible differences between the two series of compounds were apparent in respect of formative effects, translocation and decomposition within the plant and of toxicity and specificity. A. G. POLLARD.

Effect of variations in the acyl moiety on herbicidal activity of *N*-substituted α-chloroacetamides. P. C. Hamm and A. J. Speziale (*J. agric. Food Chem.*, 1957, **5**, 30—32).—The determination of the limits of the acyl moiety of the most active chloroacetamides is reported. Replacement of the single α-halogen atom, necessary for practical herbicidal activity, with other functional groups, or extension of the acyl moiety to include halo-propionamides and -butyramides results in inactivity under the conditions of the tests. E. M. J.

Controlling perennial grasses by combined operation. A. L. Abel (*Agric. Rev. Lond.*, 1956, **2**, No. 1, 32—37).—The use of TCA in conjunction with suitable cultivations for controlling certain perennial grasses, notably couch, in arable fields is described. A. G. POLLARD.

Control of triangular-stalked onion weed, *Allium triquetrum*, L. Anon. (*Tasmanian J. Agric.*, 1956, **27**, 175).—The weed was controlled by spraying, in both June and Sept., with 2 : 4-D amine or butoxyethanol ester (4 lb. acid equiv. per acre.) A. H. CORNFIELD.

Control of Bathurst burr, *Xanthium spinosum*, L. G. R. W. Meadly (*J. Agric. W. Aust.*, 1956, **5**, 161—164).—The weed was controlled by cultivation or by application of 2 : 4-D ester (1 lb. acid equiv. per acre) when the plant was small. A. H. CORNFIELD.

Serrated tussock, *Nassella trichotoma*, in New South Wales. K. R. Green (*Agric. Gaz. N.S.W.*, 1956, **67**, 8—14, 41, 123—126, 166).—The spread of serrated tussock is described. The weed is very aggressive and is not palatable to stock. Mechanical, chemical and biological methods of control are discussed. The weed is controlled with 10% $NaClO_3$ or 2·5% TCA. Diesel distillate oils are effective but expensive. A. H. CORNFIELD.

Determination of 4-chloro-2-methylphenoxyacetic acid in MCPA by a differential refractometric method. R. Hill (*Analyst*, 1956, **81**, 323—329).—The *n* of a saturated solution of pure 4-chloro-2-methylphenoxyacetic acid (**I**) is compared with that of a solution of the sample so prepared that all the impurities are dissolved and the solution is saturated with the main component. The difference in *n* of the two solutions is an accurate measure of the impurities pro-

vided that these are methyl- (**II**) or chloromethyl-phenoxyacetic acid (**III**) or both. A calibration graph is prepared with artificial mixtures of **I** and the impurities (equal parts of **II** and **III**). The total MCPA is determined where required by extraction of the chloroformic solution with aq. $NaHCO_3$, re-extraction from the separated and acidified aq. layer with chloroform and titration in ethanolic solution with 0·1N-NaOH. A. O. JONES.

Animal Husbandry

Phytate phosphorus hydrolysis and availability to rumen micro-organisms. A. Raun, E. Cheng and W. Burroughs (*J. agric. Food Chem.*, 1956, **4,** 869—871).—An artificial rumen technique involving cellulose digestion is used to test the availability of phytate P to rumen bacterial fermentation. Washed suspensions of micro-organisms hydrolyse appreciable amounts of Ca phytate as measured by the presence of inorg. P following incubation. The optimum pH for phytase activity is ~5·5 and other factors involved are concn. of micro-organisms in the medium, incubation time and substrate concn. N. M. WALLER.

Determination and stability of added DL-methionine in mixed feeds. E. L. Rohdenburg and H. R. Rosenberg (*J. agric. Food Chem.*, 1956, **4,** 872—874).—A microbiological method for the determination of DL-methionine in mixed feeds is described. The acid is extracted with water and the assay performed using *Streptococcus fæcalis* ATCC 9790. The presence of antibiotics, arsanilic acid, diphenyl-*p*-phenylenediamine, fats and a coccidiostat do not interfere. Using this procedure DL-methione in mixed feeds has been found stable for more than one year under warehouse conditions. N. M. WALLER.

Stability of vitamin D added to mineral salts [for live-stock]. G. Bährecke (*Arch. Tierernähr.*, 1956, **6,** 110—128).—Incorporation of vitamin D, cryst. or in oil solution, with mineral salts (Ca phosphates, carbonate, rock salt, trace elements) especially in presence of NaCl, Co, Mn or Cu resulted in rapid loss of activity. Vitamin D_2 dissolved in ethanol and mixed with $CaCO_3$ was much more stable (75% activity after 22 months). "Stabilized" vitamin D_3 in certain commercial prep. was not very sensitive to photo-decomposition but cryst. D_2 in $CaCO_3$ rapidly lost its activity on exposure to light. A. G. POLLARD.

Nitrogen metabolism in sheep. Protein digestion in rumen. E. F. Annison (*Biochem. J.*, 1956, **64,** 705—714).—α-Amino-N (0·3—1·5 mg./100 ml.) and α-amino-N which is liberated on hydrolysis of the diffusible peptides (0·2–1·0 mg./100 ml.) are present in rumen contents under resting conditions. A 5- or 10-fold increase in these constituents may occur during and immediately after feeding. Amino-acids are probably not absorbed from the sheep rumen. The rates of disappearance of NH_3 and amino-acids from sheep rumen after feeding casein or casein hydrolysate are increased in presence of carbohydrates. Much of the free α-amino-N of whole rumen contents is associated with the micro-organisms present. Casein, arachin and soya-bean protein are readily degraded *in vitro* by a washed suspension of rumen organisms from sheep fed on diets of hay, casein and groundnut. Bovine albumin, zein and wheat gluten are less extensively attacked. J. H. ASHLEY.

Identification of constituent amino-acids in a peptide stimulatory for lactic acid bacteria. W. E. Sandine, M. L. Speck and L. W. Aurand (*J. Dairy Sci.*, 1956, **39,** 1532—1541).—Pancreatic tissue contains two stimulants for *Lactobacillus casei* and *Streptococcus lactis* which are active in the presence of strepogenin. One stimulant, purified by chromatography, is apparently a peptide and contains lysine, aspartic acid, serine, glycine, glutamic acid, threonine, alanine, proline, valine, and probably leucine and *iso*leucine. The relation between the active stimulants in pancreatic tissue and strepogenin is discussed. S. C. JOLLY.

Digestion trials with Rhodesian feedstuffs. R. C. Elliott (*Rhod. agric. J.*, 1956, **53,** 548—555).—Maize silage was superior to Napier grass silage with respect to both digestible protein and total digestible nutrients. Over six weeks the % of protein in veld forage decreased with time whilst the % of dry matter, ether extract, crude fibre and ash showed little change. Digestible protein decreased from 59% to 22% over this period, whilst total digestible nutrients decreased only slightly. The % and digestibility of protein in Rhodes grass remained fairly constant over six weeks. A. H. CORNFIELD.

Urea as a protein supplement for ruminants. K. Humphrey (*Rhod. agric. J.*, 1956, **53,** 241—256).—A review. A. H. CORNFIELD.

Supplementary value of various proteins in animal nutrition. K. Schiller (*Arch. Tierernähr.*, 1956, **6,** 92—103).—In experiments with rats the biological value of pea protein was notably higher than that of bean or linseed protein. The value of (cod) fish meal as supplement to peas was relatively small and as that to beans could not be established definitely. A. G. POLLARD.

Mode of action of antibiotics. W. Liebscher (*Bodenkultur*, 1956, **9,** 72—87).—A review with 96 references. M. LONG.

Nutritive value of spartina grass growing in the marsh areas of coastal Georgia. P. R. Burkholder (*Bull. Torrey Bot. Club*, 1956, **83,** 327—334).—*Spartina alterniflora* contains in the dried leaves fat 2—3, protein 5—13, crude fibre 28—31, N-free extract 40—52, as well as Ca 0·7—1·0, P 0·13—0·25 and Fe 0·06—0·29%. Thiamine, riboflavin, niacin, biotin, pantothenic acid, folic acid, pyridoxine, choline and inositol are all present in the leaves, usually in greatest amounts in the young leaves. Ten amino-acids were identified in the leaves, arginine 0·21, leucine 0·36, *iso*leucine 0·22, lysine, 0·44, methionine 0·03, phenylalanine 0·15, tryptophan 0·06, valine 0·09 and threonine 0·14%. L. G. G. WARNE.

Colorimetric determination of nitrofurazone in poultry feeds. S. S. Thompson (*Analyst*, 1956, **81,** 443—444).—The method described depends upon the development of a pink colour when a 10% solution (**I**) of NaOH in 50% ethanol is added. Interfering matter is removed from the meal (5 g.) by extraction with light petroleum and then with CCl_4. The meal is then shaken with dioxan, the extract is filtered, measured, diluted with water, the turbid liquid being filtered and treated with **I**. The transient colour is measured absorptiometrically without delay. The calibration graph is prepared with standard amounts of pure nitrofurazone in 50% dioxan. Concentrates (≃11%) may be extracted directly with dioxan. A. O. JONES.

Lead content of *Torula*: dried yeast from sulphite wastes. E. Burger (*Z. Lebensmitt Untersuch.*, 1956, **104,** 434—436).—The mean Pb content of washed air-dried yeast (*Torula utilis*) from the sulphite wastes of a cellulose factory, determined on 48 samples, was 1·2 mg./kg. of yeast and was less than the highest tolerated quantities of Pb in common foodstuffs (eggs, 2·5 mg./kg., pericarp of wheat 4·8 mg./kg.). If this yeast is used therefore as a supplement to cattle fodder, Pb intoxication is not to be feared. E. M. J.

Action of urea in the feeding of milch cows. J. W. Amschler, H. Nowak and E. Walasek (*Bodenkultur*, 1956, **9,** 65—71).—The milk yields of 112 cows were examined in a 30-day feeding trial with urea. The yield of 78 cows was unchanged, whilst that of 23 was increased, the remainder giving less, i.e., 90% of the cows were not affected by the substitution of urea for part of their protein intake. Milk quality was improved, especially in the period January—April. M. LONG.

Carotene in the ration of dairy cattle. II. Influence of suboptimal levels of carotene intake on the microscopical aspect of selected organs. J. H. Byers, I. R. Jones and J. F. Bone (*J. Dairy Sci.*, 1956, **39,** 1556—1564).—Limiting the carotene intake of dairy cattle to 50 μg. per kg. of body wt. daily for two or three generations caused abnormal reproductive behaviour and often damage to the pituitary, adrenal and sex glands of the later-generation animals. Third generation calves dead at birth or blind, weak and dying, or killed shortly after birth usually showed constriction and degeneration of the optic nerve and a hydrocephalic condition. Recommended carotene allowances for dairy cattle are apparently too low if fed to >1 generation. S. C. JOLLY.

Relative value of carotene from lucerne and vitamin A from a dry carrier fed at medium to high levels to Holstein calves. J. E. Rousseau, jun., H. D. Eaton, R. Teichman, C. F. Helmboldt, E. L. Jungherr, E. L. Bacon and G. Beall (*J. Dairy Sci.*, 1956, **39,** 1565—1573).—Based on relations of plasma- and liver-vitamin-A concn. with carotene or vitamin A intake in vitamin-A-depleted calves and with vitamin-A depletion times, carotene fed at a level of 60 μg. per lb. of live wt. daily was equivalent, on a wt. basis, to ~$\frac{1}{8}$—$\frac{1}{7}$ as much vitamin A (alcohol); at 180 μg. intake level, it was equivalent to $\frac{1}{10}$—$\frac{1}{15}$ as much vitamin A and at 540 μg. intake level, to $\frac{1}{20}$—$\frac{1}{14}$. S. C. JOLLY.

Effects of oral œstrogens and androgens, singly and in combination, on yearling steers. W. M. Beeson, F. N. Andrews, M. Stob and T. W. Perry (*J. Anim. Sci.*, 1956, **15,** 679—684).—Steers receiving 10 mg. of diethylstilbœstrol (**I**) or 5 mg. of **I** + 50 mg. of methyltestosterone daily showed a 12% increase in growth rate over 179 days, the amount of increase being greater in the first 98 than in the following 81 days. The combined supplement resulted in somewhat better carcass grading than did the individual hormones or the unsupplemented ration. A. G. POLLARD.

Oral administration of diethylstilbœstrol, dienœstrol and hexœstrol to fattening calves. F. N. Andrews, M. Stob, T. W. Perry and W. M. Beeson (*J. Anim. Sci.*, 1956, **15,** 685—688).—The rate of growth of calves and the feed efficiency was increased by oral administration of either of the hormones at the rate of 10 mg. per head, daily. Carcasses from treated animals had less fat and higher moisture contents in entire rib sections. A. G. POLLARD.

Influence of oral administration of diethylstilbœstrol on certain carcass characteristics of beef cattle. J. Kastelic, P. Homeyer and E. A. Kline (*J. Anim. Sci.*, 1956, **15**, 689—700).—Administration of the hormone did not produce consistent changes in wt. or grade of carcasses or in the proportions of fat, lean and bone in rib cuts. A. G. POLLARD.

Effect of diethylstilbœstrol implantation on carcass composition and the weight of certain endocrine glands of steers and bulls. V. R. Cahill, L. E. Kunkle, E. W. Klosterman, F. E. Deatherage and E. Wierbicki (*J. Anim. Sci.*, 1956, **15**, 701—709).—Implantation of the hormone in two dosages of 84 mg. each at 84-day intervals lowered the carcass quality of steers but raised that of bulls. The proportion of fat in carcasses of bulls was increased and that of steers diminished by the treatment; also, the proportion of edible meat in steer carcasses was increased and that of bulls diminished. A. G. POLLARD.

Effects of chlortetracycline, inedible animal fat, stilbœstrol and high- and low-quality roughage on the performance of yearling steers. I. Feed consumption and rates of gain. II. Digestibility of dry matter, crude fibre, crude protein and ether extract. E. S. Erwin, I. A. Dyer and M. E. Ensminger (*J. Anim. Sci.*, 1956, **15**, 710—716, 717—721).—I. The rate of gain in wt. of steers was increased by addition of chlortetracycline to the ration; it was unaffected by stilbœstrol. Addition of inedible fat (bleachable tallow) increased the rate of gain if the ration contained lucerne but reduced it in straw-fed animals.

II. The chlortetracycline supplement decreased the digestibility of the ether extract of the ration; the fat supplement lowered the digestibility of total dry matter and of crude fibre. Stilbœstrol did not affect the digestibility of any of the nutrient fractions. In animals given lucerne the digestibility of dry matter exceeded that in animals given straw as roughage. A. G. POLLARD.

Relative usefulness of combinations of laboratory tests for predicting the fertility of bovine semen. R. W. Bratton, R. H. Foote, C. R. Henderson, S. D. Musgrave, R. S. Dunbar, jun., H. O. Dunn and J. P. Beardsley (*J. Dairy Sci.*, 1956, **39**, 1542—1549).—Statistically significant "gross" linear correlations were found between the fertility of bovine ejaculates extended 1 : 100 and 1 : 300 and the concn. of spermatozoa (*C*) in the ejaculate, % of motile spermatozoa, methylene blue reduction time, the pH, % of unstained spermatozoa, % of abnormal spermatozoa (*A*), livability of spermatozoa at 5°, and O_2 uptake of spermatozoa at 37·5°. The average non-return rates for semen extended 1 : 100 and 1 : 300 in yolk–citrate–sulphanilamide extender were 56·6 and 52·8% respectively. Of the tests that may be performed quickly after collecting the ejaculate, *C* and *A* contribute significantly to the prediction of non-return rates. For routine purposes, however, culling ejaculates on the basis of the no. of motile spermatozoa per ml. in extended semen appears to be more practicable; rejecting 50% of the ejaculates and extending the remainder 1 : 300 would make more semen available without loss of fertility than would extending all ejaculates 1 : 100. S. C. JOLLY.

Effects of glycerol level and rate of freezing, for various extenders on the survival of bovine spermatozoa frozen and stored at −79° W. M. Jones, J. R. Perkins and D. M. Seath (*J. Dairy Sci.*, 1956, **39**, 1574—1577).—Significantly higher survival % for spermatozoa in extended semen stored at −79° for two weeks were obtained with extenders containing 7% than with those containing 10 or 15% of glycerol. A chemically treated milk extender (1 ml. of 70% thioglycollic acid solution diluted to 100 ml. with 2·9% Na citrate solution per 50 ml. of milk), with an average survival % of 82·4, was superior to heated homogenized milk or yolk–citrate extenders, although at the 7% glycerol level it was inferior to the other two extenders. A freezing rate of 2·2° or 3·3° per min. down to −34·4° gave significantly higher survival % than did a rate of 1·1° per min. S. C. JOLLY.

Variations in secretion of calcium-45 by the mammary glands of dairy cows. E. W. Swanson, R. A. Monroe, D. B. Zilversmit, W. J. Visek and C. L. Comar (*J. Dairy Sci.*, 1956, **39**, 1594—1608).—The mechanisms of Ca metabolism by the lactating cow have been partly elucidated, but no satisfactory explanation has been found for the excessive proportion of radioactive Ca in the milk compared with the blood. S. C. JOLLY.

Effects of various supplementary foods on the fat content of [cows'] milk during pasturage. M. Witt (*Arch. Tierernähr.*, 1956, **6**, 61—91).—The decline in fat content of milk during the first two months after cows are turned out to grass is not readily counteracted by supplementary feeding, even if the total milk yield is increased. The decline is not related to the high protein content of young grass but is probably caused by its high water and low fibre contents. A. G. POLLARD.

Pig-feeding experiment with a vitamin-B_{12}-enriched feed. E. Kraak (*Ernährungsforschung*, 1956, **1**, 569—582).—Recent work on pig-feeding is critically examined. In feeding trials with supplements of vitamin B_{12}, regular wt. increases resulted in the treated animals. (29 references.) E. M. J.

Subcutaneous implantation of antibiotics in pellet form in suckling pigs. H. Hvidsten and B. Grotli (*Acta agric. scand.*, 1956, **6**, 138—140).—Implantation of bacitracin or bacitracin + penicillin in pigs from 2 to 50 days of age and still running with the sows had no effect on rates of growth or on the health of the piglings. A. G. POLLARD.

Pig fattening trials with inactivated penicillin. K. Tschiderer (*Bodenkultur*, 1956, **9**, 97—100).—Inactivated penicillin improves production, the increase in conversion of feed efficiency being 1·99%, equivalent to an increase of wt. of 2·7% over control. M. LONG.

Investigations of Terramycin and vitamin B_{12} additions to pig feed. K. Tschiderer (*Bodenkultur*, 1956, **9**, 88—93).—Vitamin B_{12} additions were not essential in maize-skim milk régimes. Additions of Terramycin (19 mg. daily) produced a 2·43% rise in the rate of wt. increase. The food efficiency was also increased. M. LONG.

Effects of products obtained from *Streptomyces aureofaciens* fermentation on growth and reproduction of swine. E. G. Hill and N. L. Larson (*A. R. Hormel Inst.*, 1955—56, 79—82).—Supplementing the ration of pregnant gilts with chlortetracycline (200 p.p.m.) for >80 days resulted in a significant increase in the viability of baby pigs farrowed naturally (from 55 to 78%) or by hysterectomy (from 76 to 94%); birth wt., no. of pigs per litter and no. of corpora lutea recovered as live pigs were unaffected. Placental transfer of the antibiotic did not occur. Supplementation of the ration of young pigs decreased the concn. of amines in the ileum. S. C. JOLLY.

Influence of cobalt, basic slag and copper slag on the sexual function in sheep. R. Neseni, W. Altenkirch and E. Otto (*Arch. Tierernähr.*, 1956, **6**, 104—109).—Administration of Co or of either slag (1 mg. per head daily) had no effect on the œstrous cycle of sheep. The no. of twin births was increased significantly by Co, lowered by Cu slag and unaffected by basic slag alone or in admixture with Cu slag. A. G. POLLARD.

Lucerne hay and banana trash for sheep feeding. H. Suijendorp (*J. Agric. W. Aust.*, 1956, **5**, 247).—Better wt. gains were made by wethers when they were given 0·5 lb. of lucerne per head daily + banana trash *ad lib.* than when they received either material alone *ad lib.* A. H. CORNFIELD.

Vitamin D supplements for lambs in Southern New South Wales. G. L. McClymont and P. J. Reis (*Agric. Gaz. N.S.W.*, 1956, **67**, 251—253).—Vitamin D supplements resulted in faster winter growth of weaners but had no effect on the growth rate of autumn-dropped lambs. A. H. CORNFIELD.

Relationship of thyroid activity to lactation growth and sex in sheep. O. N. Singh, H. A. Henneman and E. P. Reineke (*J. Anim. Sci.*, 1956, **15**, 625—630).—Twin lambs from ewes having high thyroid activity grew faster (wt. at 3 weeks) than did those from ewes of lower thyroid activity. This is ascribed to the larger milk consumption in the former case. Ewe lambs secreted more L-thyroxine than wether lambs: that from ram lambs was not significantly different from either. Among ewe lambs the daily secretion of L-thyroxine was directly correlated with growth rates. A. G. POLLARD.

Effect of hexœstrol on carcass composition and efficiency of food utilization in fattening lambs. T. R. Preston and I. Gee (*Nature, Lond.*, 1957, **179**, 247—249).—Lambs given implantations of hexœstrol made significantly greater daily live-wt. gains, and developed heavier carcasses, than controls. Edible meat, bone, and protein and the moisture content of the edible meat, increased more than in controls but the increase in fat was less. Treated lambs were 31% more efficient than the controls in the conversion of food to meat protein, but energetic efficiency (i.e., conversion of food to edible matter in terms of calories) was slightly less in the treated animals. (15 references.) J. S. C.

Energy and protein balance in poultry diets. W. Bolton (*Agric. Rev., Lond.*, 1956, **2**, No. 10, 19—22).—A short re-appraisal of the nutrient requirements of poultry. Typical rations in Britain tend to have somewhat higher protein contents than is necessary. A. G. POLLARD.

Freshwater fish as protein supplements for laying hens. G. H. Cooper (*Rhod. agric. J.*, 1956, **53**, 546—550).—A maize meal–freshwater fish (*Tilapia* spp.) ration was as effective as was a commercial laying mash (containing fish and meat meal, vitamins, minerals, etc.) in maintaining egg production and egg size over 13 months. Egg quality and flavour were unaffected. Protein in the freshwater fish ration was utilized much more effectively than in the commercial ration. A. H. CORNFIELD.

Activity for chicks of some vitamin B_{12}-like compounds. M. E. Coates, M. K. Davies, R. Dawson, G. F. Harrison, E. S. Holdsworth, S. K. Kon and J. W. G. Porter (*Biochem. J.*, 1956, **64,** 682—686).—Ten analogues of vitamin B_{12} are tested for vitamin B_{12} activity in chick growth. The only naturally-occurring active analogue is the 5-hydroxybenziminazole deriv. (B_{12} III) which has 4—5% of the activity of vitamin B_{12}. Four analogues with benziminazole rings in the nucleotide moiety are also active; viz., the analogues with benziminazole (23%), monomethylbenziminazole (35—41% of activity of vitamin B_{12}), and dichlorobenziminazole and naphthiminazole (both nearly as active as vitamin B_{12}). Large oral, but not parenteral, doses of *pseudo*vitamin B_{12} and factor B reduce the effect of vitamin B_{12} given simultaneously. Factor D antagonizes when given orally or by injection. Factor A and a diaminopurine deriv. are inactive but not antagonistic to vitamin B_{12}.
J. N. ASHLEY.

Effect of feeding various levels of chlorotetracycline during conditions of natural and artificial stress upon egg production, egg quality and the antibiotic potency in eggs and meat. M. A. Assem (*Dissert. Abstr.*, 1956, **16,** 1196).—Under conditions of imposed stress, addition of chlorotetracycline to the diet of laying hens at the rate of 200 g./ton of feed gave favourable response in the case of egg wt. and % shell. The addition of 10 or 200 g./ton of feed had no effect on the development of bacterial spoilage in the eggs. No antibiotic could be found in the eggs but it was detected in the meat of some birds receiving 200 g./ton of feed for long periods.
O. M. WHITTON.

Effects of detergents on growth of chickens. M. W. McDonald (*Agric. Gaz. N.S.W.*, 1956, **67,** 39—41).—Addition of 0·5% detergent (60% Na tetrapropylene-benzenesulphonate) to the diet of chicks stimulated growth to 12 weeks of age. The treatment was more effective when 6·6 p.p.m. of penicillin was also added. The detergent was not as effective as was penicillin in controlling diseases. In another test the detergent produced no growth response under conditions in which penicillin failed to produce a response.
A. H. CORNFIELD.

Genetic variation in efficiency of thiamine utilization by the domestic fowl. C. E. Howes and F. B. Hutt (*Poultry Sci.*, 1956, **35,** 1223—1229).—Thiamine utilization, as measured by the amount of the vitamin deposited in the egg, was not significantly different between rapid-feathering and slow-feathering genotypes. White Leghorns utilized thiamine 43% more efficiently than did heavy breeds.
A. H. CORNFIELD.

Morphological changes in young chickens and reproductive performance of adult chickens fed furazolidone or nitrofurazone. D. W. Francis and C. S. Shaffner (*Poultry Sci.*, 1956, **35,** 1371—1381).—Day-old chicks were supplied with 0·05% Enheptin-T (2-amino-5-nitrothiazole) (**I**), 0·0055—0·0165% furazolidone (**II**), or 0·0055—0·0165% nitrofurazone (**III**) in the feed for four weeks. Only Enheptin and the highest level of **III** reduced body wt. gains. Comb size was significantly reduced and gonad size increased by **I**. Gonad size increased with the level of **II** or **III** in the feed. When supplied at the rate of 0·022% in the feed both **II** and **III** reduced body wt. gains and thyroid wt. Addition of 0·0165% of **II** to the diet of male birds from five to eight weeks of age had no effect on body wt. gains, whilst 0·0165% of **III** and 0·2% of thiouracil (**IV**) reduced wt. gains. Comb wt. was reduced by all treatments and thyroid wt. was greatly increased by **IV**. The feeding of the nitrofurans did not change the effect of thiouracil on body wt. or thyroid size. When 0·011% of **II** or **III** was fed to laying birds for 16 weeks there was no effect on egg production, hatchability or shell quality.
A. H. CORNFIELD.

Nitrofurazone and nicarbazin as growth stimulants and coccidiostatic agents for young chickens. L. R. Berg, C. M. Hamilton and G. E. Bearse (*Poultry Sci.*, 1956, **35,** 1394—1396).—Addition of 0·0125% of nicarbazin to the feed for chicks to 11 weeks of age had no effect on growth rate but decreased feed efficiency; 0·02% of nicarbazin depressed the growth rate and reduced feed efficiency even further. At both levels birds were free from coccidial infection, developed immunity to *Eimeria tenella*, but not to *E. necatrix*. Addition of 0·0055—0·0083% of nitrofurazone to the feed had no effect on growth rate, improved feed efficiency, did not give complete protection from coccidial infection, but gave complete immunity to *E. tenella* and partial immunity to *E. necatrix*.
A. H. CORNFIELD.

Chronic toxicity to quail and pheasants of some chlorinated insecticides. J. B. DeWitt (*J. agric. Food Chem.*, 1956, **4,** 863—866).—Inclusion of aldrin, dieldrin or endrin (1—5 p.p.m.) in rations for quail and pheasant chicks caused high mortality. They survived on diets containing strobane or DDT (50 p.p.m.). Egg production, fertility and hatchability were not greatly affected by inclusion of insecticides in the diets of breeding quail, but chicks from these matings showed high mortality. Hatchability of pheasant eggs was adversely affected by aldrin, dieldrin or endrin in the reproduction diets.
N. M. WALLER.

Influence of position of eggs during storage upon their interior quality. V. Orel and F. Musil (*Poultry Sci.*, 1956, **35,** 1381—1384).—The average albumin index was 7% lower in eggs stored small end up and 14·9% lower in eggs stored small end down than in eggs stored horizontally. Candling grade was lower in eggs stored small end up than in those stored small end down.
A. H. CORNFIELD.

Use of aërosols in poultry husbandry. E. G. Harry (*Agric. Rev., Lond.*, 1956, **2,** No. 8, 30—36).—Factors influencing the efficiency of disinfectants applied as aërosols in chicken houses are considered briefly. Suitable apparatus for application is described.
A. G. POLLARD.

ET-57, a new systemic for control of cattle grub. Anon. (*Agric. Chem.*, 1956, **11,** No. 7, 43).—ET-57 (Dow Chemical Co., formula not given) when given orally to cattle (0·1 g. per kg. body wt.) effectively controlled grubs.

Control of the sheep itch mite, *Psorergates ovis*. C. R. Toop (*J. Agric. W. Aust.*, 1956, **5,** 155—160).—The mite was controlled by dipping the sheep 3—4 weeks after shearing in 1% polysulphide-S dips containing Agral 3 (6 oz. per 100 gal.).
A. H. CORNFIELD.

Contagious pustular dermatitis of sheep and goats. Anon. (*Agric. Gaz. N.S.W.*, 1956, **67,** 243—245).—Symptoms of this virus disease and methods of prevention and treatment are described.
A. H. CORNFIELD.

***Vibrio fetus* infection of cattle.** J. A. Laing (Editor) and various authors (*U.N. Fd Agric. Org.*, 1956, Agric. Studies, No. 32, 51 pp.).—The incidence of *V. fetus* infection in cattle, the application of differential culture tests, the antigenic structure of the organisms, the epidemiology, symptoms and diagnosis of the infection, the prep. of media for primary isolation, maintenance of stock cultures and antigen production, the treatment and management of the infection, and prevention and control of genital vibriosis, are the subjects covered in a summary of a symposium held in Copenhagen in 1952. (38 references.)
J. S. C.

Bacteriological studies of "infected" and "uninfected" chicks in relation to antibiotic growth stimulation. M. Lev, C. A. E. Briggs and M. E. Coates (*Nature, Lond.*, 1956, **178,** 1125—1126).—The presence of spores of *Clostridium welchii* type A in the cæca of chicks, is related to an infective growth-depressing condition. Distinct differences were found, in the presence and activity of *Cl. welchii*, in the first few days of life between chicks from clean and infected premises and between infected and penicillin-fed chicks. The metabolism of *Cl. welchii* in infected chicks appears to be altered by penicillin in the diet, the effect on the host being equivalent to elimination of the organism.
J. S. C.

Malathion for control of the northern fowl mite and lice. W. M. Reid, R. L. Linkfield and G. Lewis (*Poultry Sci.*, 1956, **35,** 1397—1398).—Treatment of individual birds with 5% malathion dust or of hen houses with the dust (1 lb. per 20 sq. ft.) gave excellent control of lice but less satisfactory control of the northern fowl mite.
A. H. CORNFIELD.

Changes in serum lipins of chickens infected with Newcastle disease. D. Kritchevsky, R. F. J. McCandless and F. S. Markham (*Poultry Sci.*, 1956, **35,** 1393).—The presence of Newcastle disease resulted in a decrease in total serum-lipins, the most marked change being in fatty acid content.
A. H. CORNFIELD.

Supersaturated borate and borate–chlorate solutions. Borax Consolidated, Ltd. (Inventor: G. A. Connell) (B.P. 747,656, 16.9.52).—Na diborate (containing >5 mol. of water of hydration) is dissolved at 5—20° in presence or absence of $NaClO_3$ and/or H_3BO_3, to give a weed-killing solution supersaturated with respect to borax.
F. R. BASFORD.

Thiadiazole compositions. Boots Pure Drug Co., Ltd. (Inventors: H. A. Stevenson, W. A. W. Cummings and J. F. Cranham) (B.P. 748,422, 7.8.53).—A thiadiazole carrying halogeno- or nitro-benzylthio groups in the 2- and 5-positions, is suitably compounded, to provide a composition for use in the control of eggs of mites and larvæ, especially red spider (*Tetranychidæ*). Thus, a mixture of 2 : 5-dimercapto-1 : 3 : 4-thiadiazole, NaOH, abs. EtOH and *p*-nitrobenzyl chloride, is boiled during 30 min., then diluted with water, with pptn. of 2 : 5-*di*-(p-*nitrobenzylthio*)-1 : 3 : 4-*thiadiazole*, m.p. 141·5—142°.
F. R. BASFORD.

New compositions comprising sulphur-containing compounds [acaricides]. Boots Pure Drug Co., Ltd. (Inventors: H. A. Stevenson, D. Greenwood and J. E. Cranham) (B.P. 747,909, 7.8.53).—

1 : 2-Dichloro-1 : 2-di(phenylthio)ethylene is compounded with solid or fluid carrier, to provide an acaricidal composition. F. R. BASFORD.

New fluorine-containing compounds. Boots Pure Drug Co., Ltd. (Inventors: H. A. Stevenson, N. G. Clarke, J. E. Cranham and D. J. Higgons) (B.P. 748,604, 2.3.53).—Compounds $SR{\cdot}CH_2{\cdot}R'$ are claimed as acaricides (R and R' are phenyl groups at least one of which contains at least 1 F and may optionally contain Cl). As an example of prep., *p*-fluorobenzyl bromide is added to a solution of Na (0·9) in thiophenol in anhyd. EtOH, then after 2 hr. at the boil, the mixture is poured into water, with pptn. of p-*fluorobenzyl phenyl sulphide*, m.p. 62—62·5°. F. R. BASFORD.

Neutral esters of dithiophosphoric acid. Farbenfabriken Bayer A.-G. (B.P. 748,299, 27·7·53. Ger., 1·8·52).—Compounds $(OR)_2PS{\cdot}S{\cdot}[CH_2]_x{\cdot}SR'$ of improved miticidal properties, are obtained, e.g., by interaction of $(OR)_2PS_2H$ with $SR'{\cdot}[CH_2]_x.X$ at 18—80° in an org. solvent in presence of a binding agent (R is alkyl of 1—3 C; R' is alkyl of 1—2 C; *x* is 1—2). Thus 2-chloroethyl methyl sulphide is added slowly to a mixture of K *OO*-diethyl·phosphorothiolothionate and acetone at 20°, temp. rising to 40°, then after 2 hr. at 50—55° the cooled mixture is filtered. Residue obtained by evaporation of the filtrate is worked up to give OO-*diethyl* S-*methylthiomrthyl phosphorothiolothionate* (47 g.) b.p. 113—114°/15 mm. When this (0·001—0·005%) is aq. solution containing a wetting agent is sprayed on to bean plants infested with red spider, complete control is rapidly attained and the plants remain immune for several weeks. F. R. BASFORD.

2.—FOODS

Amino-acid supplementation of cereals. C. A. Elvehjem (*Cereal Sci.*, 1956, **1**, 162—164).—Data are reported, derived from experiments, in which rats were fed with rice, corn and wheat, supplemented with different combinations of amino-acids and growth data and changes in liver fat observed. The results are discussed in terms of a theory of amino-acid imbalance. J. S. C.

Free amino-acids of fresh and aged parboiled rice. I. R. Hunter, R. E. Ferrel and D. F. Houston (*J. agric. Food Chem.*, 1956, **4**, 874—875).—Eighteen free amino-acids were identified by filter-paper chromatography of adsorption-dialysis extracts of parboiled rice. Decreases in size and intensity of spots from oven-aged rice indicated significant losses of amino-acids during storage. (15 references.) N. M. WALLER.

Continuous rotary filtration of maize gluten. B. A. Schepman, B. Martin and D. A. Dahlstrom (*Chem. Engng Progr.*, 1956, **52**, 423—427).—An account of pilot plant studies on the filtration of gluten slurry, using a string discharge, 3 ft. diam. × 2 ft. face rotary vacuum filter. The solids could be discharged evenly even when the cake was only $\frac{1}{8}$ inch thick, and filtration followed normal rules. The maximum output of dry solid was 12 lb./hr./sq. ft. of filter area, obtained as a cake with 66% moisture. Data on moisture-drying time and on output solid concn. in slurry are also presented. F. RUMFORD.

Effect of the delay accompanying use of the combine harvester on physical and chemical properties of soft red winter wheat. M. Pool (*Dissert. Abstr.*, 1956, **16**, 1036—1037).—Delayed harvest of wheat improved grain quality by increasing granulation, pearling, and break from yields; did not affect total flour yield, protein or ash contents; sometimes affected viscosity index, Mixogram area and cookery quality and reduced the test weight of grain. Drying was increased in the cases of awns and non-waxy glumes rather than waxy glumes. Evidence is presented to support the hypothesis that pearling indices measure density and coarseness of internal kernel structure and the elasticity and plasticity of cell walls, while granulation indices measure fine flour production. O. M. WHITTON.

Colour measurement of wheat flour. A. W. Croes (*Chem. Weekbl.*, 1956, **52**, 431—432).—In using the Kent-Jones and Martin flour colour grader (*Analyst.*, 1950, 127, and *Baker's Digest*) the grading is assessed by comparing the light reflected from a sample of flour, mixed with water, with that reflected from a standard white surface. According to the present author lightness is only one of the factors involved in judging the whiteness of flour. By using a photo-electric reflection meter with three filters, amber, blue and green, it is possible to measure both whiteness and yellowness. While, in general, the latter decreases as the former increases, there is no strictly linear relation between the two, hence it is not possible to judge the yellowness by measuring the whiteness alone. It is shown by means of a graph of measurements of a number of different samples, but especially in the case of a so-called Inlandse Patent-bloem, that while there is little difference in lightness there may be considerable differences in yellowness in individual measurements. P. HAAS.

Use of ion exchangers for determining grade of flour. J. Pomeranz and C. Lindner (*Analyt. chim. Acta*, 1956, **15**, 330—334).—The water-sol. electrolyte content (*E*) of flour can be determined by passing a filtered suspension of the sample through a H-ion exchange column, and titrating the liberated acid in the eluate. A separate titration of any acid originally present should be made. The method, which is valid in the presence of added $CaCO_3$, can replace the usual ash test for evaluating the extraction rate of flour. A linear equation relates the " original " ash content with *E* (provided the sample is not pure bran). A spot-test for determining, to within 0·1%, the amount of added $CaCO_3$ is described. W. J. BAKER.

Routine determination of admixed chalk in flour. R. Sawyer, J. F. C. Tyler and R. E. Weston (*Analyst*, 1956, **81**, 362—366).—Two methods for checking the chalk (creta) content of flour are described. In the colorimetric method the diminution of colour of chloranilic acid solution by pptn. of its Ca salt is measured absorptiometrically against water at 540 mμ. In the flame photometric method the flour is heated with dil. HCl and acetic acid in an autoclave, the hydrolysate is treated with $ZrO(NO_3)_2$ and aq. NH_3 to remove PO_4''' and the Ca is then determined in the flame photometer against a control solution. These methods are conveniently applicable to the routine examination of large numbers of samples. Results are compared with those of the gasometric method previously described (Frazer *et al.*, Brit. Abstr., 1950, C, 457). A. O. JONES.

Destruction of vitamin E in flour by chlorine dioxide. T. Moore, I. M. Sharman and R. J. Ward (*J. Sci. Food Agric.*, 1957, **8**, 97—104).—Chemical estimations of the tocopherols present in wheaten flours indicated that treatment with ClO_2 caused almost complete destruction of each of the tocopherols. Untreated flour can supply adequate amounts of vitamin E to rats, but flour which has been treated with ClO_2 is quite inactive as a source of the vitamin. Baking involves a loss of 47% of vitamin E of untreated flour, but this bread contains an adequate amount of vitamin E for rats. Bread made from dough treated with K bromate and ascorbic acid contained as much vitamin E as bread made from untreated flour. The " aëration " process caused loss of vitamin E, but was much less destructive than ClO_2 treatment. (11 references.) E. M. J.

Physico-chemical properties of cereal starches. R. D. Patel and R. S. Patel (*J. Indian chem. Soc., Industr. Edn*, 1956, **19**, 131—135).—The starch content, structure of starch granule, moisture content, ash content, P content, alkali-labile value, period of dextrinization and intrinsic viscosity (**I**) of cereal starches are determined. Starches obtained from various kinds of cereals vary in respect of their grain size, P content, alkali-labile value, period of dextrinization and **I**. **I** determined by using 0·5N-NaOH as dispersing medium varies from 1·75 for wheat starch to 1·495 for moriyo in the increasing order moriyo, rice, cheno, kodari, bavato, bajari, jowar, wheat. I. JONES.

Consequences of solvent extraction on the structure and behaviour of the starch granule. K. Altau (*Dissert. Abstr.*, 1956, **16**, 1209—1210).—A series of alcohol extractions of fatty acids from maize starch was performed with various lower alkanols at concn. of 30–100% alcohol. The extent of fatty-acid removal is quant. correlated with the length of the alcohol mol., their degree of branching and their concn. The presence of water moderated the alcohol-film density inside maize starch helices. Methanol of concn. <55 mol.-% was the least effective extractant but >65 mol.-% the most effective. Compared with parent starches, extracted starches had a strengthened surface structure and high alkali no. indicating increased strain in the granule. Alkali numbers were generally independent of alcohol concentration and of extraction time after 2 hr. A distinct difference between fat-by-hydrolysis values for glutinous and non-glutinous starches was correlated with the difference in structure of the starches. O. M. WHITTON.

Digestibility of cereal starches by Taka-diastase and pancreatin at different pH and at 38·5 ± 0·01°. R. D. Patel and R. S. Patel (*J. Indian chem. Soc.*, 1956, **33**, 615—617).—The digestibility of cereal starches (bavato, kodari, ghau, chokha, jowar, bajari, moriyo and cheno) by Taka-diastase and pancreatin at different pH and at 38·5 ± 0·01° has been studied. The optimum pH for digestibility for all starches has been found to be 6·5. Taka-diastase has better activity than pancreatin. The max. digestibility of different starches is approx. the same. O. M. WHITTON.

Measurement of enzymic amylolysis. II. [A, B] Methods depending on determination of decrease in viscosity of starch paste (viscosimetric determination of amylase). III. Methods depending on determination of the turbidity-clearance of glycogen or starch solution (nephelometric determination of amylases). IV. Methods depending on the study of the iodine–starch reaction (examination of starch break down by the [colour] change of the iodine reaction). H. Wildner and G. Wildner (*Brauwissenschaft*, 1956, **9**, 262—272, 296—302, 310—313;

1957, **10,** 10—18).—II. [A] Descriptions are given of the construction and operation of several forms of apparatus for following the course of changes in η, and of calculations for evaluating results in terms of amylolytic activity. (45 references.)

II. [B] Descriptive reviews are given of the construction and operation of several types of viscometer as modified for the determination of the decrease in the η of starch solutions due to amylolytic activity. The prep. of the appropriate starch solutions is described, and examples are given of applications of the methods to extracts of barley, malt and other diastatic prep. P. S. ARUP.

III. A glycogen solution (91 ml. of $\gtrless$0·3%) prepared from the liver of a freshly killed rabbit, given 50 ml. of a 50% solution of glucose 2—3 hr. previously, is placed in each of a series of cylinders (100 ml.), 1—3 ml. of M/3 phosphate buffer and 1 ml. of 0·1N-NaCl solution are added and mixed; the temp. is kept at 37° ± 0·05, 5 ml. of amylase solution (0·5—3·0 ml. of human saliva diluted to 100 ml.) at the same temp. are added and mixed. After 30 sec. 15 ml. are taken out of each cylinder and each sample is placed in a dry flask in ice water. Tests are made after 10 or 15 min. The turbidity at 0° is not recognizable, but changes with time and nephelometric examination is soon possible. The results are calculated from the equation $c_1 = 100 \times h/h_1$ where c_1 is the concn. of the cleavage product, h and h_1 are the nephelometric standard and experimental comparison respectively. A standard glycogen curve is prepared.

IV. A review with 42 references. E. M. J.

Relationship of age with strain retardation in a starch gel. C. Sterling (*Food Res.*, 1956, **21,** 680—688).—Creep and recovery measurements were made on a starch gel at different ages and with varying loads. The modulus of elasticity and coeff. of "viscosity" increased with gel age, while total strain attained and rate of ageing increased. Little moisture loss occurred during storage. There was an intrinsic retrogradation of the polysaccharide mol., i.e., increased parallel association at micellar junction points, to strengthen the network in the gel. (22 references.) E. M. J.

Lines of attack on dough chemistry. I. Hlynka and J. A. Anderson (*J. agric. Food Chem.*, 1957, **5,** 56—59).—Baking tests, still remaining the final criterion of flour quality, rheological techniques including the examination of dough properties by structural relaxation curves and relaxation time spectra, and analytical methods including amperometric titrations and polarographic determinations are discussed in relation to contributions to the knowledge of dough chemistry. An adequate hypothesis of dough structure consistent with experimental data is needed whatever type of flour is used or however the data is obtained. (18 references.) E. M. J.

Alleged occurrence of vitamin A in baker's yeast. F. W. Heaton, J. S. Lowe and R. A. Morton (*J. chem. Soc.*, 1956, 4094—4095).—Yeast, after incubation in an O_2 atm., was extracted with ether and the extracts examined. Vitamin A was not detected but a substance with an absorption max. at 272 mμ. and an inflexion near 330 mμ. was found in small quantities and closely resembles the substance "SA," hitherto found in animal products only. (Cf. Festenstein *et al.*, *Biochem. J.*, 1955, **59,** 558; J.S.F.A. Abstr., 1955, i, 376.) J. S. C.

Automatic pilot plant control in the development of micro-organisms. G. J. Fuld and C. G. Dunn (*Food Technol.*, 1957, **11,** 15—18).—A discussion of several experiments, e.g., bakers' yeast propagation, utilizing the automatic control system (sugar and pH) with the pilot plant fermenter (50 gal.). (16 references.) E. M. J.

Comparative determinations of cellulose. K. Stolk (*Chem. Weekbl.*, 1956, **52,** 682—687).—A critical assessment of four different methods for the determination of cellulose was made by testing them on two kinds of filter paper and on a sample of air-dry autumn grass. The methods tested were those of (i) Norman and Jenkins (*Biochem. J.*, 1933, **27,** 818), (ii) Crampton and Maynard (*J. Nutr.*, 1938, **15,** 383), (iii) Viles and Silverman (*Analyt. Chem.*, 1949, **21,** 950), and (iv) Weender, as modified by Holdefleisz and by Camper (*Landbouwk. Tijdschr.*, 1949, **61,** 785). Certain minor improvements were made in testing methods (i) and (ii) and in method (iii) the temp. conditions for hydrolysis were controlled by heating the material with 60% w/v H_2SO_4 immersed in a water bath for 5 min. at 95° and for 10 min. at 90°. Method (i) was not considered suitable for a series of technical determinations; although it gave somewhat higher values than the other methods, the mean deviations of methods (i), (ii) and (iv) were such as to indicate their general reliability. Method (ii) tested on grass gave a markedly lower result than the other methods. All three methods (ii), (iii) and (iv) are regarded as being suitable for serial analyses. P. HAAS.

Micro-method for separation and determination of polysaccharides by zone electrophoresis. K. W. Fuller and D. H. Northcote (*Biochem. J.*, 1956, **64,** 657—663).—A zone electrophoretic method is described for the quant. separation of neutral polysaccharides. The strip support is silk and the method gives 85% recovery of a 4-component mixture that contains 100 μg. of each polysaccharide. The advantages of electrophoresis on strip supports are discussed. A qual. zone electrophoretic method is also described with glass paper as support and *p*-anisidine as a general spray reagent. The electrophoretic movement of neutral polysaccharides depends on use of borate buffer. J. N. ASHLEY.

Separations of carbohydrates on charcoal columns in the presence of molybdate. S. A. Barker, E. J. Bourne, A. B. Foster and R. B. Ward (*Nature, Lond.*, 1957, **179,** 262—263).—A mixture of maltose and melibiose was eluted from a charcoal–"Celite" column impregnated with molybdate. The eluent was an aq. molybdate solution of constant molarity but increasing ethanol content. It was found that melibiose was largely unaffected by the molybdate, but that elution of maltose was accelerated, as compared with the reverse effect in borate-impregnated columns. The separation of the maltose series of oligosaccharides is also accelerated by molybdate. J. S. C.

Water adsorption on sugar cane fibre. F. H. C. Kelly (*Int. Sug. J.*, 1957, **59,** 36—38).—Adsorption isotherms indicate that moisture is attached to sugar cane fibre by adsorption forces which are greater than those of simple condensation and that energy is expended in breaking this bond as well as in vaporizing the water. Equilibrium relationships between water and the fibre are similar to those of other fibres which have been examined. J. S. C.

Colour evaluation in the cane sugar industry. V. R. Deitz (*J. Res. nat. Bur. Stand.*, 1956, **57,** 159—170).—A colour scale is proposed in which colour of a sugar solution is evaluated by the amount of departure from a colourless sucrose solution. A chart is presented to enable the colour value to be directly read from data of attenuation at wavelengths 420 and 560 mμ. Results in good agreement with visual colour estimation were obtained. (13 references.) J. S. C

The lead error in the polarization of British raw beet sugars. L. Eynon, A. E. Tate, J. F. T. Oldfield and J. G. N. Gaskin (*Int. Sug. J.*, 1957, **59,** 38—39).—The effects of the basic Pb acetate, used in both wet and dry forms, on the polarization of a representative selection of raw beet-sugar samples were determined. For a raw sugar of polarization = 94, the true correction per ml. of Pb (solution of sp. gr. = 1·25) added in wet form is 0·08—0·16 and, for polarization = 97, between 0·03 and 0·07. For dry Pb added, the correction, at polarization of 97, is between +0·05 and −0·07 per mg. Pb added. J. S. C.

Moisture control in sugar. L. G. Joyner (*Mod. Packaging*, 1956, **29,** No. 12, 180—184, 238—240, 242, 244).—The mechanism of caking of brown and powdered sugars and the proper choice of packaging materials for the prevention of caking have been investigated. Brown sugar packed in cartons having different types of liners was stored at 100°F. and less than 30% R.H. for periods up to 94 days and the loss in weight, as well as the effect of additional creasing of the liners on weight loss were determined. The best liner was a kraft/Al foil/tissue paper laminate, a three-ply wax-laminated paper liner was next best, whereas a single waxed sheet was worst. Creasing of the liners was shown to have the greatest effect on moisture loss. A certain amount of moisture loss is, however, essential, particularly for brown sugar, which might otherwise turn "sour" on prolonged storage. Overpackaging should therefore be avoided as much as underpackaging. K. WENDTNER.

New colorimetric method for estimation of reducing sugars. II. J. K. Roy (*J. Indian chem. Soc., Industr. Edn*, 1956, **19,** 83—86).—The colorimetric method of Mitra and Roy (*ibid.*, 1955, **18,** 34) is successfully used for the estimation of sucrose in commercial cane sugar, sucrose and invert sugar in molasses, and starch in different foodstuffs such as rice, atta, flour, barley and potato. I. JONES.

Chemistry and the sugar cane. L. F. Wiggins (*J. R. Soc. Arts*, 1956, **105,** 31—42).—The agriculture and technology of the sugar-cane industry are reviewed and the use of sucrose as a chemical raw material is discussed. Among the possible products are sucrose monostearate, which has detergent properties, and its analogues (such as sucrose monolaurate), 2-methylpiperazine, glucose and fructose, mannitol and sorbitol, and dextran. The uses of molasses, including ammoniation products, of bagasse, and filter cake (as a source of hard wax and org. chemicals) are also briefly described. J. S. C.

Applications of Complexones to sugar analysis. M. Potterat and H. Eschmann (*Ann. Falsif., Paris*, 1956, **49,** 464—479).—The

accuracy and reproducibility of the Luff–Schoorl procedure for determining sugars are improved by the use of Complexone III instead of citric acid in the prep. of the Luff–Schoorl solution. The max. error with a test sample containing 2·5—35 mg. of sugar ≡ 0·04 mg. of glucose. Calibration tables and graphs are given for determinations of glucose, fructose, lactose and maltose. P. S. ARUP.

Effect of copper contamination on the development of colour in the processing and storage of honey. E. Einset and W. L. Clark (*Food Technol.*, 1957, **11**, 10—14).—Samples of honey exposed to Cu contamination contained a higher level of Cu than their respective controls without Cu treatment, but this difference was not reflected in % transmission [of light] for colour development during storage at 122°F. Initial differences in % transmission were markedly influenced by times and temp. of processing only in the case of dark buckwheat honey. E. M. J.

Sugars present in the fruit of acerola, *Malpighia punicifolia* L. R. Santini, jun., and A. S. Huyke (*J. Agric. Puerto Rico*, 1956, **40**, 87—89).—Paper chromatography showed the presence of glucose, fructose and sucrose in the fruit of acerola. A. H. CORNFIELD.

Characterization of pectin changes in freestone and clingstone peaches during ripening and processing. H. L. Postlmayr, B. S. Luh and S. J. Leonard (*Food Technol.*, 1956, **10**, 618—625).—In clingstone peaches pectin change was slight during maturation resulting in firm fruit and a preference for heat processing >18 min., intrinsic η of pectic materials isolated by Versene extraction from the canned fruit decreased from 9·6 to 7·2 as the average pressure test of the fresh fruit decreased from 10·4 to 5·1 (lb. pressure to cause penetration of plunger to $\frac{1}{16}$ inch); extended processing time increased the syrup η. In freestone peaches protopectin was converted into water-sol. pectin during ripening, with softening of the texture; intrinsic η of pectins of the canned fruit dropped from 6·8 to 1·9 as the pressure test of the fresh fruit decreased from 11·9 to 0·85 lb. (23 references.) E. M. J.

Shikimic acid in apple fruits. A. C. Hulme (*Nature, Lond.*, 1956, **178**, 991—992).—By gradual elution from anion-exchange resins, very small quantities of an acid, which was identified by chromatographic behaviour and sp. rotation as shikimic acid, were detected in extracts of the peel of Bramley's seedling apples. The acid is barely detectable in the peel of unripe apples but increases with ripening and senescence. (10 references.) J. S. C.

Quercetin-galactoside and chlorogenic acid in Ontario apples. H. Kathen (*Z. LebensmittUntersuch.*, 1957, **105**, 22—24).—The prep. of the above mentioned substances and their identification by paper chromatography and measurement of their absorption spectra are described. E. M. J.

Natural coating of apples. III. Saturated acids of the cuticle oil. J. B. Davenport (*Aust. J. Chem.*, 1956, **9**, 416—419).—The cuticle oil extracted from the natural coating of ripe Granny Smith apples was saponified with ethanolic KOH and, after acidification of the aq. solutions at 0°, the total acids (~60 wt.-% of the oil) were extracted with Et_2O. The saturated acids (10·3 wt.-% of the oil) were then separated by low-temp. crystallization and freed from hydroxy-acids by passing the Me esters through a column of SiO gel. Fractional distillation (148·2—189·6°) of the esters gave the following % composition of the saturated acids: stearic 45, arachidic 39, palmitic 4, behenic 6 and higher mol.-wt. acids 7. W. J. BAKER.

Occurrence of *leuco*-anthocyanin in pears. M. A. Joslyn and R. Peterson (*Nature, Lond.*, 1956, **178**, 318).—Halved ripe California Bartlett pears gave a strong positive test for *leuco*-anthocyanin, in the core tissue surrounding the seeds and in the seeds, when tested with vanillin reagent. The red anthocyanin pigment developed by acidification of the extract was examined by paper chromatography and its R_F values for several solvent systems corresponded closely with those reported for cyanidin, with which it exhibited other similarities, e.g., stability to oxidation. J. S. C.

Formation of organic acids in fruits preserved in an atmosphere rich in carbon dioxide. R. Ulrich and J. Landry (*C. R. Acad. Sci., Paris*, 1956, **242**, 2757—2759).—Pears preserved at 0° in air containing 10% CO_2, and examined periodically by paper chromatography, were found to accumulate malic and succinic acids. The mechanism of their formation is discussed in the light of other published work (cf. J.S.F.A. Abstr., 1954, ii, 126). J. S. C.

Graphical method of determining best temperatures for preserving bananas in fresh state after cutting and before their climacteric ripening. Method of cooling or warming. A. Tsalpatouros (*C. R. Acad. Sci., Paris*, 1956, **242**, 2761—2764).—A graph showing the respiration curves at 12·5—30·5° of bananas, over a period of 19 days, has been constructed to enable optimum conditions of treatment to be determined on the basis of avoiding unnatural metabolic changes. J. S. C.

Occurrence of pectin methylesterase in guavas. I. G. Rieckehoff and A. Rios (*J. Agric. Puerto Rico*, 1956, **40**, 90—92).—Pectin methylesterase was detected in guavas. It is suggested that partial demethoxylation of the pectin in the nectars and subsequent formation of insol. pectinates with bivalent cations may be responsible for the formation of insol. gel-like particles in some canned guava nectars. A. H. CORNFIELD.

Effects of diphenyl on respiration of oranges and lemons. I. L. Eaks (*Proc. Amer. Soc. hort. Sci.*, 1955, **66**, 135—140).—Diphenyl (5 g. per fruit chamber containing 50 fruit) decreased the respiration rate of orange and lemon fruits injured and inoculated with *Penicillium italicum* and *P. digitalum* but increased it with uninoculated fruit, both injured and uninjured. L. G. G. WARNE.

Determination of residual *p*-chlorophenyl *p*-chlorobenzenesulphonate in orange pulp. G. J. Butzler, E. N. Luce and R. E. Wing (*J. agric. Food Chem.*, 1957, **5**, 42—44).—A method for the determination of the acaricide, Ovex, in orange pulp depends on the hydrolysis of Ovex to *p*-chlorophenol and Na benzenesulphonate. The *p*-chlorophenol, separated by steam distillation, is converted into the nitroso compound under controlled conditions; interfering materials are separated by chromatography, and the *p*-chlorophenol is measured colorimetrically. The method is sensitive to <5 μg. of Ovex, with a recovery of 90%. E. M. J.

Structure of "hydroxy-α-carotene" from orange juice. A. L. Curl (*Food Res.*, 1956, **21**, 689—693).—"Hydroxy-α-carotene," a widely occurring minor carotenoid constituent occurring in oranges, peaches and leaves has, when derived from orange juice, the probable structure 3-hydroxy-α-carotene, in which the hydroxyl group is on the β-ionone ring. A substance with this structure would not be a provitamin A. (16 references.) E. M. J.

Autoxidation and mechanism of action of carotene. C. Bodea, E. Nicoară, M. Florescu and J. Gross (*Rev. Chim., Bucharest*, 1956, **1**, No. 1, 133—142).—It is deduced from the bleaching of indigo by solutions of α- or β-carotene in presence of air, and the inhibition of the autoxidation of aldehydes until the carotene is decolorized, that carotene reacts with air to form a hydroperoxide. This hydroperoxide then reacts with further carotene to form an epoxide and a hydroxy deriv. Chromatographic analysis of the air oxidation products of β-carotene (**I**) suggests that the primary product is **I**-3-monohydroperoxide which reacts with **I** to give **I** mono- and di-epoxides (**II**) and 3-monohydroxy-**I** (kryptoxanthin) (**III**). **II** then isomerize to the furanoids mutachrome, luteochrome and aurochrome. **III** forms a further hydroperoxide which reacts as above giving the numerous xanthins which have been identified. The function of carotene in plants is to be a peroxide buffer, acting either as a donor or accepter of active oxygen. (16 references.) A. B. DENSHAM.

Current refrigeration problems of interest to the citrus industry. D. C. McCoy (*Food Technol.*, 1957, **11**, 23—27).—A survey covering the cooling of food immediately after harvest (pre-cooling), the holding of food under refrigeration until time of prep. for the table; in this connexion hydro-cooling, mechanically refrigerated rail trucks and refrigeration in the retail store are discussed. (11 references.) E. M. J.

Composition of commercial, segment and peel juices of Florida oranges. L. J. Swift and M. K. Velhuis (*J. agric. Food Chem.*, 1957, **5**, 49—52).—Compared with corresponding values in orange-juice, commercially or hand-extracted, pH, Brix–acid ratio, sol. pectic substances, ascorbic acid, flavonoids, diacetyl and colour were higher in peel juices, and acidity and fluorescence were lower; sol. solids, sp. gr. and η were generally higher in peel juices; and in the early part of the season reducing sugars were higher and sucrose was lower. Peel juices (3%) added to reconstituted concentrate had a detectable significance. (10 references.) E. M. J.

Cloud stability of frozen superconcentrated citrus fruit juices. R. J. McColloch, R. G. Rice, B. Gentili and E. A. Beavens (*Food Technol.*, 1956, **10**, 633—635).—In orange concentrates of >4-fold concn. the enhanced cloud stability results from the effects of varying concn. of sugars and citrate, not from reduced activity of pectinesterase. E. M. J.

Capacity of the anaërobic flax-retting organisms *Clostridium felsineum* and *Plectridium pectinovorum* to ferment pectin in presence of various nitrogenous compounds. V. A. Alekseev (*Mikrobiologiya*, 1956, **25**, 327—330).—Pure cultures of the organisms ferment citrus fruit and flax pectins in presence of $(NH_4)_2CO_3$ or peptone, with production of acetic and butyric acids. R. TRUSCOE.

Distribution of vitamins of the B-complex in mother juices and their residues occurring in fruit juice extraction. A. Scheunert and H. Haenel (*Ernährungsforschung*, 1956, **1**, 520—525).—Data are presented on the contents of thiamine, riboflavin, nicotinic acid,

pyridoxine and inositol in juice from, and corresponding residue of, species of common fruits, raspberries, strawberries, currants, etc., including B-vitamin contents (of each species) in 70 ml. of expressed juice + 15 g. of residue (dry basis) corresponding to the contents in 100 g. of fruit. A large proportion (~70%) of the B-vitamin contents remains in the residue, and is lost to human nutrition. (14 references.) E. M. J.

Microbiological study of the content of factors of the B-complex in foods and fodders. H. Haenel (*Ernährungsforschung*, 1956, **1**, 533—540).—Values determined by microbiological methods are given in nine tables: to include the contents of B-vitamins in horse chestnut and elder juice; cucumbers; sweet musts and fruit juices; fruit wines and syrups; fruit juice concentrates and vegetable juices; in fruit juices compared with the necessary daily amounts for growth; in fodder to which edible fungi are added; in several products, e.g., brewer's yeast, melted cheese, white cabbage, etc.; rye bread, wheat germ prep. and wheat bran, etc. E. M. J.

Effect of storage on vitamin C, thiamine and colour in some bottled juices. G. A. Dhopeshwarkar and N. G. Magar (*J. Indian chem. Soc., Industr. Edn*, 1956, **19**, 78—82).—The effect of storage on the acceptability and retention of ascorbic acid in bottled orange juice is studied. Juice is discoloured after four months' storage at 37°. The intensity of reddish-brown discoloration is considerably lower in samples stored at room temp. Retention of ascorbic acid is 58·8% after storage for six months at 37° compared with 77·8% at room temp. De-aëration helps better retention of both vitamin C and thiamine in pineapple juice; de-aërated tomato juice retains more ascorbic acid only, and de-aërated mango juice does not show any difference in the retention of either vitamin. (13 references.) I. Jones.

West Indian cherry—richest known source of natural vitamin C. C. G. Moscoso (*Econ. Bot.*, 1956, **22**, 280—294).—The fruits of *Malpighia punicifolia* contain from 1000 to 4000 mg. of vitamin C per 100 g. of edible matter. L. G. G. Warne.

Respiration of cucumber fruits associated with physiological injury at chilling temperatures. I. L. Eaks and L. L. Morris (*Plant Physiol.*, 1956, **31**, 308—314).—At non-chilling temp. the rate of CO_2 production decreased with duration of storage whereas at chilling temp. the rate increased with time to a plateau which was followed by a decline. Respiration rate and drift at 25° following chilling could be used as a rough index to the severity of treatment. Respiratory quotients of fruits held at a non-chilling temp. of 15° were near unity whereas at chilling temp. the quotients were less than unity during the time of the onset and development of injury. E. G. Brickell.

Softening of cucumbers during curing. A. L. Demain and H. J. Phaff (*J. agric. Food Chem.*, 1957, **5**, 60—64).—The possible sources of the softening agents which break down the pectic materials of the middle lamella of cucumbers during curing are reviewed. Recent work implicates certain yeasts and moulds, e.g., *Geotrichum candidum*, as causal organisms, aërobic bacilli probably playing a less important part in softening than was thought formerly. (63 references.) E. M. J.

Effect of tomato cell structures on consistency of tomato juice. R. T. Whittenberger and G. C. Nutting (*Food Technol.*, 1957, **11**, 19—22).—The internal structure and composition of the tomato is discussed especially in regard to the quality of the juice from the various parts. Maturity of tomatoes and preheat treatment affected juice structure composition and consistency. Max. consistency was obtained when both cell walls and pectins were present in quantity. Consistency depends on the quantity, shape and degree of subdivision of the cell walls present, and the character of the walls as determined by the occurrence of pectins. (10 references.) E. M. J.

Residues in crops treated with *iso*propyl *N*-(3-chlorophenyl)carbamate and *iso*propyl *N*-phenylcarbamate. L. N. Gard and J. L. Reynolds (*J. agric. Food Chem.*, 1957, **5**, 39—41).—The method of Gard and Rudd (*ibid.*, 1953, **1**, 630—632) for the measurement of *iso*propyl *N*-(3-chlorophenyl) carbamate (CIPC) (cf. J.F.S.A. Abstr., 1955, i, 170) was applied to grapes, tomatoes, strawberries, etc.; peas were tested for *iso*propyl *N*-phenylcarbamate residue. The method gave a 90% recovery when the herbicide was added in the range of 0·05 to 0·5 p.p.m. of CIPC. Harvested crops which had been treated with CIPC did not contain residues in excess of 0·05 p.p.m. (the low sensitivity limit). E. M. J.

Flavour of selected vegetables grown in pesticide-contaminated soils. G. L. Gilpin, A. B. Parks and H. Reynolds (*J. agric. Food Chem.*, 1957, **5**, 44—48).—Flavour and general acceptability scores for root vegetables and green beans grown without insecticide treatment on plots previously used for crops treated with technical BHC, lindane, or α, β or δ isomers of BHC, at heavy dosage levels, were generally significantly lower than scores for the controls and for the other test samples, grown on soils previously treated with other chlorinated hydrocarbons. (14 references.) E. M. J.

Action of lipoxidase in frozen raw peas. A. C. Wagenknecht and F. A. Lee (*Food Res.*, 1956, **21**, 605—610).—The presence of lipoxidase in frozen raw peas, and its partial purification are reported, including the action of bringing about peroxidation of pea lipins and the destruction of chlorophyll in blanched peas. E. M. J.

Influence of vining on the development of off-flavours in frozen raw peas. F. A. Lee, A. C. Wagenknecht and R. Graham (*Food Res.*, 1956, **21**, 666—670).—Peroxide values of extracted crude lipins obtained from peas stored in the pods longer than 62 days were considerably larger than those found in the crude lipins extracted from peas which were vined previous to storage. Total and reducing sugars and sucrose were higher, and greater chlorophyll degradation took place, in peas stored in pods. Peas stored at −17·8° unblanched in pods retained good eating quality for approx. a month; unblanched vined peas declined in quality after approx. a week. E. M. J.

Estimation of α-keto-acids in plant tissue: critical study of various methods of extraction as applied to strawberry leaves, washed potato-slices and peas. F. A. Isherwood and C. A. Niavis (*Biochem. J.*, 1956, **64**, 549—558).—Use of hot acid or strongly alkaline media, or boiling methanol, for inactivation of the enzymes in strawberry leaves, washed potato slices and peas, causes formation and destruction of α-keto-acids in the tissue extract during disintegration. Any method of heat inactivation, however short, may cause a significant change in the α-keto-acid content. In the best method, the tissue is frozen in a mixture of methanol and solid CO_2, and is then disintegrated in 0·6M-HPO_3 at −2°. J. N. Ashley.

Physical and chemical factors influencing the colour of potato chips. A. T. Habid (*Dissert Abstr.*, 1956, **16**, 841—842).—The Hunter Colour Meter is an accurate means for objective measurements of chip colour. There was low correlation between chip colour and sp. gr. and total solids content of the raw potato, and high correlation with reducing sugar content, but varieties identical in their characteristics gave different colour in chips. Low values of ratio of reducing sugars to total sugars and of amino-acids are associated with light-coloured chips. Before frying potatoes stored at 40°F. conditioning at 75°F. for three weeks was necessary to produce light-coloured chips. Frying at 375° gave better results than frying at 350° or 400°F. H. S. R.

Reduction of errors in vegetable analysis by flame spectrometry. M. Pinta and C. Bove (*C. R. Acad. Sci., Paris*, 1956, **243**, 179—181).—A method for correcting for phosphorus interference with the flame-spectrometric determination of Ca^{II} in vegetable tissues or liquids is described. A graph is given for making the appropriate adjustments. J. S. C.

The onion: gaseous emanation products. W. D. Niegisch and W. H. Stahl (*Food Res.*, 1956, **21**, 657—665).—The volatile constituents of onions were examined by mass spectrometric and i.r. spectroscopic analysis of vapours trapped at various low temp. in the absence of air. The presence of *n*-propyl mercaptan, methyl alcohol, propionaldehyde, acetaldehyde, and CO_2 was established. The presence of other compounds was indicated but not confirmed. (11 references.) E. M. J.

Extracts of seaweed. M. Enginger (*Chim. et Industr.*, 1956, **76**, 758—760).—The manufacture and properties of alginates and carragheenates from seaweed are reviewed. J. S. C.

Application to fruit products of a toxicological method of alcohol determination. P. Dupaigne (*Industr. agric. aliment.*, 1956, **73**, 789—792).—For the determination of small amounts of alcohol in fruit juices, etc., two methods are described and compared, a chemical method based on oxidation of the alcohol by $K_2Cr_2O_7$ and a physical method based on separating the alcohol from the water in the aq. distillate with anhyd. K_2CO_3. (16 references.) J. S. C.

Biotin content of grapes and wines. E. Peynaud and S. Lafourcade (*C. R. Acad. Sci., Paris*, 1956, **243**, 1800—1802).—Biotin was determined in grape musts and white and red wines by observation of the growth and acidity developed of *Lactobacillus arabinosus*, after 72 hr. incubation at 35°, in a culture medium. In some 20 samples of fresh musts from ripe grapes, biotin content was 1·5—4·2 μg./l. (mean 2·63 μg.). For 56 red Bordeaux wines, the value varied at 0·6—4·6 μg. (mean 2·15 μg.) and for 30 white Bordeaux wines, 1·0—3·6 μg. (mean 1·97 μg.). Variations in biotin content during ripening of the grape and during fermentation were also studied. J. S. C.

Determination of nicotinamide in Bordeaux wines. S. Lafourcade (*Industr. agric. aliment.*, 1956, **73**, 779—786).—The forms of nicotinamide capable of estimation with the use of *Lactobacillus arabinosus*,

before and after an alkaline hydrolysis, were determined in grapes during the course of maturing, in musts during fermentation and in large numbers of white and red Bordeaux wines. The results are tabulated. Mean values (mg./l.) are: for ripe grapes 1·20 (free) and 3·26 (total); for white wines, 0·82 (free) and 1·57 (total); and for red wines, 1·31 (free) and 1·89 (total). 17 references.)
J. S. C.

Routine determination of phosphoric acid in wine-ash. J. Schneyder (*Mitt. Wein-u. Obstbau, Wien*, 1956, **6A**, 309—313).—The method described gives results in good agreement with those obtained by a standard method. The acid solution of the ash is first freed from Fe^{+++} and Al^{+++} by treatment with a cation-exchanger, and then titrated to a pure grey coloration with 0·1N-KOH in presence of a mixed indicator containing methyl orange, bromocresol green, and methyl red. The H liberated after the addition of a slight excess of $CeCl_3$, determined by titration to the same end-point, gives a measure of the H_3PO_4 present. (22 references.)
P. S. Arup.

Development of the utilization of vine products for human nutrition. J. M. X. Fagüeña (*Bol. Inst. Invest. Agron. Madrid*, 1956, **16**, 75—113).—A review. L. G. L. Unstead-Joss.

Manufacture of wine vinegars. A study of fermented product quality. E. F. Mariño (*Bol. Inst. Invest. Agron., Madrid*, 1956, **16**, 47—74).—The fermentation of wine and synthetic alcohol-containing nutrient mixtures follow parallel courses, i.e., the acidity of the brew rises as the alcohol content falls; the ester content rises to a max. when approx. half the alcohol has been fermented away, declining afterward; the aldehyde content shows a parallel, but much smaller rise and fall. Data are presented for the fermentation rates of the wine under still conditions in a flask or barrel where the surface–volume ratio is small and where there is no agitation, and for commercial conditions using agitation. (21 references.)
L. G. L. Unstead-Joss.

Biochemical study of the vinegar eel-worm. C. Gerpe (*Rev. Ferment. Industr. aliment.*, 1956, **11**, 67—69; cf. J.S.F.A. Abstr., 1956, ii, 67). J. S. C.

Pilot plant study of utilization of leucine by *Saccharomyces cerevisiæ*. J. W. Spanyer, jun. and A. T. Thomas (*J. agric. Food Chem.*, 1956, **4**, 866—868).—The utilization of leucine by yeast was followed in a series of pilot plant fermentations in which the leucine–*iso*amyl alcohol system was studied. The results showed that the amount of fusel oil formed is approx. a linear function of the amount of leucine added. (12 references.)
N. M. Waller.

Occurrence of the phospholipase B in barley malt. L. Acker and H. Bücking (*Z. LebensmittUntersuch.*, 1957, **105**, 32—38).—In addition to phospholipase D, a phospholipase B was found in barley malt, capable of splitting lecithin into fatty acid and glycerophosphoric acid–choline ester. It has the following characteristics: it is bound to cell structures and can be extracted with water and separated by ultra-filtration and ultra-centrifugation. Separation from phospholipase D is effected by Permutit. Optimum temp. and pH are 25° and 6·0—6·3 respectively. The choline-ester obtained is split again with a Permutit separable enzyme. Phospholipase D may therefore be considered a phosphodiesterase of general activity. E. M. J.

Barley and malt. IX. Apparatus for experimental malting. A. D. Davis and J. R. A. Pollock, (*J. Inst. Brew.*, 1956, **62**, [New Series **53**], 383—389).—A miniature plant, capable of malting several small samples of barley together under a wide range of precisely-controlled conditions, is described. J. S. C.

Factors influencing the production of polyhydric alcohols by osmophilic yeasts. J. F. T. Spencer, J. M. Roxburgh and H. R. Sallans (*J. agric. Food Chem.*, 1957, **5**, 64—67).—Certain yeasts which produce considerable quantities of glycerol, erythritol and D-arabitol during normal growth are discussed. Satisfactory yields of glycerol and D-arabitol were obtained from, e.g., *Saccharomyces rouxii* or *S. mellis* in 5-l. stainless steel fermentors with glucose–yeast extract–urea medium or glucose–maize steep liquor and a higher concn. of urea. Increased rates of aëration and raising of temp. to 37° increased the glycerol yield. Ratios of glycerol and D-arabitol produced, to glucose metabolized, of 0·29 and 0·31 g. per g., respectively, giving a combined yield of 0·60 g. of polyols per g. of glucose were obtained. (11 references.) E. M. J.

Non-fermentability of melanoid substances. A. G. Zabrodskiĭ and V. A. Vitkovskaya (*Mikrobiologiya*, 1956, **25**, 318—326).—Melanoid substances, prepared by autoclaving glucose–glycine solutions, stimulate vital processes of yeast cultures (multiplication, senescence, death) in farinaceous mashes; they are not themselves metabolized, so that their carbohydrate content does not contribute to alcohol production. At concn. of about 5% they depress the activity of malt amylase. R. Truscoe.

Fermentation of farinaceous mashes by a thermophilic strain of yeast. *R. V. Feniksova, L. G. Loginova and A. A. Shilova (Mikrobiologiya, 1956, **25**, 310—317).—A strain of Saccharomyces cerevisiae* XII adapted to growth at 37—39° was as effective in fermenting rye mash saccharified with malt at 38° as was the parent strain at 30°. Mashes saccharified with aspergillus or rhizopus amylases were somewhat less efficiently fermented at 38°. R. Truscoe.

Finings. I. Swelling of isinglass and action of finings on yeast suspensions. A. D. Rudin (*J. Inst. Brew.*, 1956, **62**, [New Series **53**], 414—419).—The swelling of isinglass was studied in detail and a method for preparation of finings in 2 hr. evolved. Interaction between selected yeasts and finings in various liquids showed varying degrees of retardation of flocculation in presence of salts, indicating a factor controlling the speed of fining of yeasts in beer. Flocculation appears to be related to the fibrous structure of finings. (21 references.) J. S. C.

Influence of light on sporulation of brewing yeast. W. F. F. Oppenoorth (*Nature, Lond.*, 1956, **178**, 992).—Experiments with bottom yeasts showed that one strain showed a remarkable increase of sporulation on exposure to daylight, another strain showed inhibited sporulation, and a third type was indifferent to light: the last was observed only with badly sporulating yeasts. Further investigations are projected. J. S. C.

Yeast inoculation equipment—method for sampling, dispatch and analysis of yeast samples for biological examination. H. Hecht (*Brauwelt*, 1957, **97B**, 141—144).—Spoilage of samples during transit can be avoided by the use of the equipment which consists of a wooden block carrying two sample-tubes fitted with rubber stoppers carrying pipettes furnished with rubber bulbs. The first tube contains a sterile medium which is selective for beer-spoilage organisms, and coloured with a pH-indicator. A sample of the yeast is transferred to the medium by means of the pipette. On arrival at the laboratory, the tube can be incubated at 25° preparatory to the biological examination of the contents. The second tube contains a wad of cotton wool impregnated with a moisture-indicator; the pipette in this tube is filled with a sample for direct microscopical examination. P. S. Arup.

Reversal of quaternary ammonium detergent inhibition of *Saccharomyces cerevisiæ* by a fraction derived from yeast extract. M. A. Rich and A. M. Stern (*Canad. J. Microbiol.*, 1956, **2**, 453—459).—The separation and activity of the yeast extract fraction is described. Preliminary examination of the nature of the active material and the mode of its action are recorded.
A. G. Pollard.

Comparative studies of methods of hop analysis. II. Estimation of humulone and other resin constituents. L. R. Bishop (*Brasserie*, 1956, **11**, 255—274).—Cf. J.S.F.A. Abstr., 1956, i, 167. J. S. C.

General composition of non-biological hazes of beers and some factors in their formation. II. Chromatographic separation of hop and malt tannins. G. Harris (*J. Inst. Brew.*, 1956, **62**, [New Series **53**], 390—406).—Polyphenolic constituents of hops and of malt were examined by paper chromatography. Several individual hop tannins were identified by u.v. spectra. Several flavonol glucosides including *iso*quercitrin, quercitrin, rutin, chlorogenic acid, etc.) were detected. (48 references.) J. S. C.

Beer haze and draught beer retailing. L. Macher (*Brauwelt*, 1957, **97B**, 105—109).—Directions are given for the cleaning and disinfection of beer engines and accompanying equipment. Biological and chemical deposits are frequent causes of haze, but sudden changes in CO_2 pressure can cause the pptn. of unstable colloidal proteins. P. S. Arup.

Nature of protein-trub. E. Sandegren (*Brauwissenschaft*, 1956, **9**, 272).—The water-sol. fraction of beer-trub contains a high-mol. protein fraction (rich in N and S), the dissolution of which depends on the presence of a fraction (poor in N) of lower mol. wt. The content in bottled beer of the high-mol. fraction increases on ageing. A second high-mol. fraction (containing less N and S than the former), which is sol. only in a buffer solution of pH 8·5, shows no similar increase. Recorded discrepancies in the composition of various beer-trubs can be explained in the light of these findings. Determinations of changes in redox potential and ITT values of bottled beer during storage under various conditions indicate a connexion between trub formation and a reduction–oxidation process in which S- and N-containing compounds (possibly also traces of Fe and Cu) play an important part, and which can occur in the absence of O_2. Trub formation is probably connected with deterioration in taste. P. S. Arup.

Refractometric analysis of beer. Development of calculated formulæ for alcohol and actual extract from the refractive index and the specific gravity of beer [A and B]. E. Schild and G. Irrgang

(*Brauwissenschaft*, 1956, **9**, 314—323; 1957, **10**, 19—24).—[A] The literature from 1843 is discussed. Accurate analyses of the last ten years indicate that present-day beer values cannot be satisfactorily determined by former calculated formulæ, probably because raw materials have changed, e.g., barleys with poorer protein are used and the fermentation grade of modern beer is higher. The relations between sp. gr., n, and original wort of samples of beer were studied and new formulæ developed. These values when compared with results of distillation analyses were in good agreement and were greatly superior to those of the old refraction processes. The subject matter is mathematically discussed. (15 references.)

[B] Data are given on 35 beer samples analysed by distillation and refraction processes. Two fundamental equations, forming the basis for development of formulæ, are discussed: (i) Sp. gr. of a beer = sp. gr. of the dealcoholized portion + sp. gr. of alcoholic distillate (both made up to original vol.) — 1. (ii) The n of a beer = n of the dealcoholized portion + n of the alcoholic distillate (both made up to original vol.) — n of the distilled water. Tests made within the limits of full beer and strong beer indicated a close correspondence between the calculated and the actual values.

E. M. J.

Pasteurization of bottled beer. F. X. Pirzer (*Brauwissenschaft*, 1956, **9**, 288—295).—Factors bearing on the expulsion of CO_2 from bottled beer and its subsequent redissolution are examined. The experimentally determined coeff. of cubic expansion of a bottle-glass is greater than the coeff. calculated from the composition of the glass. The coeff. of cubic expansion of beer is greater than that of water, and is proportional to the extract content. From a critical examination of published data for the solubility of CO_2 in beer, it is concluded that this does not differ materially from the solubility in water. Conflicting published data for the max. pressure developed in the bottle during pasteurization of beer are critically examined. The pressure developed in the bottle after pasteurization and cooling to 10° is, owing to the expulsion of CO_2 and its incomplete redissolution, greater than the initial pressure, and attains a constant value of 1·45 atm. excess pressure, irrespective of the vol. of the empty space. (26 references.)

P. S. Arup.

Pasteurization of bottled beer. F. X. Pirzer (*Brauwissenschaft*, 1956, **9**, 324—330).—The coeff. of expansion of bottle glass determined experimentally was $28{\cdot}62 \times 10^{-6}$ compared with 21×10^{-6} mainly quoted in brewing literature. The coeff. of expansion of beer, original gravity of 12% was $37{\cdot}33 \times 10^{-5}$ compared with that of water $34{\cdot}39 \times 10^{-5}$. The coeff. of expansion of beer rose linearly as the original gravity of beer increased. The partial pressure developing in a bottle during pasteurization caused by the setting free of CO_2 was determined; the amount of CO_2 liberated at (*a*) pasteurization temp. and (*b*) after pasteurization was calculated; CO_2 was given off as the beer cooled. Initial pressure of CO_2 had no influence on the turbidity of the beer caused by pasteurization.

E. M. J.

Use of preservatives in the brewery. U. Strohm-Hoffmann (*Brauwissenschaft*, 1956, **9**, 254—261).—A review covering attempts at preserving beer by various irradiation procedures, and by the addition of antioxidants, antibiotics and antiseptics. (35 references.)

P. S. Arup.

Phenolic substances of manufactured tea. I. Fractionation and paper chromatography of water soluble substances. E. A. H. Roberts, R. A. Cartwright and N. Oldschool (*J. Sci. Food Agric.*, 1957, **8**, 72—80).—Methods are described for the fractionation of the complex mixture of phenolic substances and their oxidation products occurring in manufactured tea. The oxidation products found included S I and S II mainly responsible for the intensity of colour of the tea infusion and nine unidentified substances, A, B, C, D, P, Q, X, Y and Z. S I and S II have acidic properties, and mean mol. wt. of 600. They are probably mixtures of dimers, each dimer consisting of two oxidized flavonol units. X and Y have no acidic properties and are characterized by several colour reactions. P may be an anthocyanidin. (21 references.)

E. M. J.

Ascorbic acid in maté. II. Quantitative. R. C. R. Barreto (*Rev. Quim. industr. Rio de J.*, 1956, **25**, No. 291, 14—16).—Purification of the extract from maté for the estimation of ascorbic acid, as described in the previous communication (J.S.F.A. Abstr., 1957, *i*, 151), was unsatisfactory as the relatively large number of operations, necessitated by that process, caused the loss of a considerable quantity of the vitamin. Ion-exchange resins such as Amberlite IR-4B were found to retain the ascorbic acid with 99·5% efficiency and the colour of the eluate from the resin was quite satisfactory for the use of an indicator such as 2 : 6-dichlorophenolindophenol.

H. Pritchard.

Determination of caffeine in foodstuffs. J. Eisenbraud and D. Pfeil (*Z. anal. Chem.*, 1956, **151**, 241—258).—A spectrophotometric method based on the extinction max. at 273 mμ. for the estimation of caffeine (**I**) in coffee, tea, maté and cola is described. The molar extinction ϵ for **I** after checking the spectrophotometer with KNO_3 solution is given as 9342 ± 0·5%. For many purposes **I** can be estimated in extracts by direct spectrophotometry. The following correction gives good agreement in many cases with the gravimetric method: ϵ 273 mμ. corrected = ϵ 273 mμ. − ½(ϵ 310 mμ. + ϵ 245 mμ.). A paper chromatographic method using butanol–water–acetic acid solvent which separates **I** from trigonelline is described; the **I** spots are detected by the use of an u.v. lamp, extracted with water and estimated spectrophotometrically. A simple maceration with boiling water extracts ≮94% of **I** from ground coffee, etc.

P. S. Stross.

Preparation and characterization of aliphatic 2 : 4-dienals. D. A. Forss and N. C. Hancox (*Aust. J. Chem.*, 1956, **9**, 420—424).—Small amounts (~2 g.) of 2 : 4-heptadienal (b.p. 58—60°/5 mm.), 2 : 4-nonadienal (b.p. 72—74°/3 mm.) and 2 : 4-hendecadienal (b.p. 80—81°/1 mm.) can be prepared by a general method involving chain lengthening of a 2-enal by two C atoms in a Doebner synthesis with $CH_2(CO_2H)_2$, reduction of the resultant dienoic acid with LiAl hydride, and oxidation of the dienol with MnO_2 in an inert solvent. The crude product (50% purity) is treated with 1 : 2-dianilinoethane to form the tetrahydroimidazole deriv. which is well-suited for the characterization and prep. of the pure aldehyde. The u.v. absorption spectra of the three dienals and of their semicarbazones and 2 : 4-dinitrophenylhydrazones are listed. The u.v. spectra of the aldehydes shows an intense broad max. at 273·5 mμ. (95% EtOH) with mol. extinction coeff. of 23,000—29,000. The i.r. spectrum of 2 : 4-heptadienal indicates an all-*trans* configuration for these aldehydes as prepared by the Doebner synthesis. The dienals were required for comparison with substances isolated in work on the development of oxidation taints in milk (cf. Forss *et al.*, *J. Dairy Res.*, 1955, **22**, 91—102).

W. J. Baker.

Possibility of copper-induced oxidation of milk in stainless steel–white metal systems. E. W. Lusas, E. W. Bird and W. S. Rosenberger (*J. Dairy Sci.*, 1956, **39**, 1487—1499).—An oxidized flavour defect, which either increased during storage (8 days at 4°) or tended to decrease on the 6th and/or 8th day, developed in milk of low bacterial content which had passed through stainless steel tubing with white metal fittings. The defect was possibly caused by the increase (0·095 p.p.m.) of Cu resulting from passage of the milk through the system; the Ni content increased by 0·04 p.p.m. but the Fe content was unchanged.

S. C. Jolly.

Some physical properties of milk. III. Effects of homogenization pressures on the viscosity of whole milk. C. H. Whitnah, W. D. Rutz and H. C. Fryer (*J. Dairy Sci.*, 1956, **39**, 1500—1505).—Data obtained with an Ostwald viscometer at 4—49° on whole milk pasteurized at 62° for 30 min., homogenized at 59° at pressures of 15—3500 lb. per sq. in., and stored at 4° for 50 hr. indicated specific linear increases in η with temp. Increasing homogenization pressure from 1000 to 3500 lb. per sq. in. increased η compared with unhomogenized milk by 7·1—15%. At pressures <300 lb. per sq. in. and temp. >23°, linear relationships were usually significant; at lower temp. significant linear and quadratic trends were absent.

S. C. Jolly.

Specificity of milk lipase. I. Determination of lipolytic activity in milk towards milk fat and simpler esters. II. Kinetics and relative lipolytic activity in different milks. III. Differential inactivation. E. N. Frankel and N. P. Tarassuk (*J. Dairy Sci.*, 1956, **39**, 1506—1516, 1517—1522, 1523—1531).—I. Under the most favourable conditions, the pH optima for the hydrolysis of milk fat (homogenized cream) (**I**), polyoxyethylene (20) sorbitan monolaurate (Tween 20) (**II**), and Me butyrate (**III**) by milk lipase were 8·8—9·1, 8·8 and 8·0 respectively; the pH optimum of 8·7—8·9 for the hydrolysis of tributyrin (**IV**) was confirmed.

II. Values for the max. velocity for the lipolytic activity in milk towards **I, II** and **III** were 1·6, 2·4 and 2·1 (units per 100 ml.) respectively; values for the Michaelis–Menten constant (Hofstee, *Science*, 1952, **116**, 329; *J. biol. Chem.*, 1952, **199**, 357) were 6·3, 0·81 and 0·54 respectively, and for activation energy at 30—37° were calc. to be 6200, 14,500 and 12,500 cal. respectively. Variations in the relative lipolytic activity found in different milks towards different substrates indicates the possible presence of multiple lipolytic enzymes in milk. Limitations of the kinetic approach are discussed.

III. Ageing, heating, acids, alkalis, light, H_2O_2, Cu and formaldehyde caused greater inactivation of milk lipases towards **II, III** and **IV** than towards **I**. Trypsin had a greater effect on the activities towards **I** and **IV** than on those towards **II** and **III**. This differential inactivation is further evidence of the presence of multiple lipolytic enzymes in milk, and until these enzymes have been separated only **I** should be used as substrate for the determination of lipase in milk. The term "lipase" should not be used

for the tributyrinase or the simple esterase activity of milk; "lipase system" is suggested as a term to cover the multiple lipolytic enzymes of milk. S. C. JOLLY.

Milk lipase system. I. Effect of time, pH and concentration of substrate on activity. II. Effect of formaldehyde. D. P. Schwartz, I. A. Gould and W. J. Harper (*J. Dairy Sci.*, 1956, **39**, 1364—1374, 1375—1383).—I. The results indicate that two or more lipases may be potentially active in raw skim milk.

II. Formaldehyde appeared to behave as a competitive inhibitor and also, under suitable conditions, as a selective inhibitor of milk lipases. The data substantiate the previous findings that milk contains a multiple lipase system. S. C. JOLLY.

Methyl sulphide and the flavour of milk. S. Patton, D. A. Forss and E. A. Day (*J. Dairy Sci.*, 1956, **39**, 1469—1470).—Methyl sulphide (detection and identification described) may contribute *significantly to the characteristic flavour of milk. A flavour threshold concn. of 12 parts per billion (American) in distilled water was determined, and at slightly higher concn. Me sulphide was* responsible for a milk-like flavour. S. C. JOLLY.

Rapid method for estimating total protein in milk. D. C. Udy (*Nature, Lond.*, 1956, **178**, 314—315).—The reaction of milk proteins with the anionic dye, Orange G, to form an insoluble complex is used to provide a rapid method of estimation. The concn. of unbound dye at equilibrium, measured in a special absorption cell of short light-path with a 470-mμ. filter in an Evelyn photoelectric colorimeter, shows a linear relation with protein content determined by a standard macro-Kjeldahl method. Formulæ are developed for liquid whole and spray-dried milk. J. S. C.

Viscosity of milks. P. S. Kulkarni and K. K. Dole (*Indian J. Dairy Sci.*, 1956, **9**, 68—79).—The relationships between η and the fat and solids-not-fat contents in buffalo, cow, goat and asses' milk were studied. For genuine whole milk η is a non-linear function of the total solids; and, in turn, of the fat and of the solids-not-fat-content. The relationship varies from milk to milk and from sample to sample of the same milk, but it affords a means of estimating solids-not-fat when η and fat content are known and also of differentiating a poor genuine milk from an adulterated milk. Viscosity decreased with rise in temp. (25° to 35°); and the temp. coeff. was smaller for whole than for skim milk. Removal of fat caused by a lowering in η, the larger-sized fat globules having more effect. G. HELMS.

Effect of temperature and time on the creaming of cow, buffalo, sheep and goat milk. H. H. Fahmi, I. Sirry and A. Safwat (*Indian J. Dairy Sci.*, 1956, **9**, 80—86).—The rates of formation of the cream layer vol. (C.L.V.) and the fat contents of the skim milks were studied for milks stored at 22° and 10° ± 2°. From 100 c.c. at 22°, the vol. of cream for cow, buffalo, sheep and goat were, respectively, 8·0, 11·3, 9·3 and 3·0 c.c. after one day, 8·3, 11·8, 11·0 and 4·0 after two days, and 7·7, 11·8, 13·3 and 6·0 after four days. Sheep and goat milk creamed much more slowly than did cow or buffalo milk. With the refrigerated samples, cow milk reached full vol. in one day and fell by about 20% in the next four days; the other three milks creamed very slowly, the % increase in C.L.V. from the 1st to the 5th day for buffalo, sheep and goat being 119, 167 and 320% respectively. The efficiency of skimming was greater at 10° than at 22° with cows' milk, but the reverse was true for the other three milks which were devoid of fat clusters in comparison with cows' milk. G. HELMS. (11 references.)

Some carbonyl compounds in raw milk. W. J. Harper and R. M. Huber (*J. Dairy Sci.*, 1956, **39**, 1609).—α-Oxoglutaric acid (average 2·5 mg. per l.), pyruvic acid (~0·25 mg. per l.), acetone and acetaldehyde were detected in all of 20 samples of fresh milk; acetoacetic acid (in 11), oxaloacetic acid (in 8), oxalosuccinic acid (in 3) and α-oxocaproic acid (in 1 sample) were also found. Formaldehyde and unidentified aromatic carbonyl compounds and carbonyl compounds with chains of <5 C atoms were present in some samples. Addition of 10 mg. of α-oxoglutaric acid or 2 mg. of pyruvic acid to 1 l. of pasteurized milk had no apparent effect on the flavour. S. C. JOLLY.

Vitamin B_6 in sterilized milk and other milk products. A. Z. Hodson (*J. agric. Food Chem.*, 1956, **4**, 876—881).—Modifications of the *Neurospora sitophila* 299 and *Saccharomyces carlsbergensis* methods of assay of vitamin B_6 give similar though not identical results when applied to fresh or pasteurized milk or to non-fat dry milk solids. When applied to evaporated milk, particularly after storage, the first method gives higher results than the second. Experimental work suggests that during processing and storage pyridoxal of fresh milk is changed progressively to pyridoxamine and then to an unknown form of vitamin B_6 which is not equally active for both assay organisms. (18 references.) N. M. WALLER.

Riboflavin in milk. V. V. Modi and E. C. Owen (*Nature, Lond.*, 1956, **178**, 1120).—Samples of the milk of cows, goats, ewes, rabbits, mares, sows and humans were extracted to obtain an aq. phase containing all the riboflavin and examined by paper chromatography and electrophoresis. With milk from the first four spp., the presence of both free riboflavin and flavin adenine dinucleotide (**I**) was demonstrated: in that from the remaining three, only **I** was found. Preliminary experiments indicated that xanthine oxidase was absent from the milk of the second group (human, mares, sows) but present in the milk of the first four spp. J. S. C.

Feeding studies on vitamin- and mineral-fortified whole milk. L. J. Teply, R. F. Prier and H. J. Scott (*Food Res.*, 1956, **21**, 671—679).—Moderate vitamin (and trace mineral) supplementation, above min. requirements for growth and physiological functions in rats, were tested using commercially available vitamin D mineral concentrates designed for fortifying whole milk. *Reproduction was good and no deleterious effects of the vitamin and mineral substances were observed.* E. M. J.

Co-vitamin studies. II. Influence of feed on the tocopherol, carotene and vitamin-A contents in milk and butterfat. K. M. Narayanan, C. P. Anantakrishman and K. C. Sen (*Indian J. Dairy Sci.*, 1956, **9**, 87—94; cf. J.S.F.A. Abstr., 1956, ii, 200).—In controlled feeding tests with six cows and two buffaloes, the intake of tocopherol, carotene and vitamin A was periodically varied by altering the ingested levels of concentrate mixture (oats, grain, groundnut cake, wheat bran and grainhusk), green grass and *ragi* straw. The analytical data on the milk and milk fat showed that the vitamin-A and tocopherol contents of the milk depended on the carotene intake, a finding in agreement with that of earlier workers. An adequate daily supply of 35—50 lb. green fodder is necessary to maintain the vitamin content of the milk at a fairly high level. G. HELMS. (14 references.)

Qualities of recombined milk with coconut fat type replacement. B. J. Samala (*Araneta J. Agric.*, 1956, **2**, No. 4, 49—109).—In rat-feeding trials reconstituted milk, in which butterfat was replaced by coconut fat, was superior to that in which other vegetable fats (soya-bean, groundnut, cottonseed) were used for replacement. Normal fresh milk produced somewhat better growth than either of the reconstituted milks tested. A. G. POLLARD.

New high-temperature pasteurization processes: instrumentation and control. H. B. Robinson (*J. Milk Tech.*, 1957, **20**, 9—12).—Equipment, incorporating new design features and supplementary controls, for pasteurization of milk products at temp >190°F with only momentary holding is described and reviewed. J. S. C.

Thermal inactivation of the organism of Q fever in milk. J. B. Enright, W. W. Sadler and R. C. Thomas (*J. Milk Tech.*, 1956, **19**, 313—318).—Investigations of the times and temp. required to eliminate the causative organism of Q fever (*Coxiella burnetii*) from cows' milk show that the present min. standard of pasteurization by the vat method of 143°F. for 30 min. is inadequate. A temp. of 145°F. for 30 min., however, will eliminate the organism. Pasteurization by the "high-temp.-short-time" procedure of 161°F. for 15 sec. also destroys it. (23 references.) J. S. C.

Stability of small concentrations of penicillin in milk as affected by heat treatment and storage. K. M. Shahani, I. A. Gould, H. H. Weiser and W. L. Slatter (*J. Dairy Sci.*, 1956, **39**, 971—977).—When heated at 143° or 160°F. for 30 min. or at 250°F. for 15 min., solutions of K penicillin (0·13—1·07 i.u. per ml.) were more stable in milk than in phosphate buffer (pH 6·0) or water. On storage at 34—38°F. penicillin was lost more rapidly in milk and water than in buffer; the losses in milk heated at the higher temp. were less than those in milk that was not heated or heated at 143°F. There was no correlation between concn. and degree of inactivation. When assayed by the disc method, penicillin in milk developed smaller inhibition zones than did the same concn. in water or buffer. K penicillin *O* was the form of penicillin that was most stable (average loss 0·9%) and ephenamine penicillin *G* the least stable (average loss 16·1%) to pasteurization at 143°F.; potency losses for procaine penicillin (7·6%), K penicillin (10·9%) and benzylpenicillin (13·1%) were intermediate. Penicillin is relatively more stable to heating but less stable on storage than are streptomycin and aureomycin. S. C. JOLLY.

Antibiotics, alone or associated in milk. P. Dopter (*C. R. Acad. Agric. Fr.*, 1956, **42**, 519—522).—The use of penicillin in mammary infections and the further treatment with aureomycin and streptomycin alone or in conjunction with penicillin to control streptococci, staphylococci and coliform bacilli resistant to penicillin, the retarding of the development of lactic ferments by the antibiotics and the possible detrimental effects in making Gruyere or Camembert cheeses are discussed. E. M. J.

Rapid calculation of logarithmic average bacterial counts of milk. J. C. Schilling (*J. Milk Tech.*, 1956, **19**, 319—322).—A slide-rule device is described which considerably facilitates the calculation of logarithmic averages of plate counts. J. S. C.

Payment for milk according to its bacteriological quality. III. Corrected notation applied to results of alcohol tests on milk as received at the factory: method of correction based on the growth rate as a function of atmospheric temperature. M. Sainclivier (*Industr. agric. aliment.*, 1956, **73**, 793—797).—Equations representing the variations of bacterial growth rates with temp. of milk samples are obtained and are used to develop a systematic method of correction by which alcohol tests, as previously described (*ibid.*, 1955, **72**, 583; 1956, **73**, 449) can be extrapolated to give the bacteriological quality at the time of actual milking. J. S. C.

Agar culture medium for lactic acid streptococci and lactobacilli. P. R. Elliker, A. W. Anderson and G. Hannesson (*J. Dairy Sci.*, 1956, **39**, 1611—1612).—A medium has been developed which is suitable not only for lactic streptococci but also for other lactic acid bacteria found in dairy products, as well as for bacterial counts on silage and other materials supporting lactic fermentation. This "lactic agar" has the following % composition: tryptone 2, yeast extract 0·5, gelatin 0·25, dextrose 0·5, lactose 0·5, sucrose 0·5, NaCl 0·4, Na acetate 0·15, ascorbic acid 0·05, and agar 1·5; pH 6·8 before sterilization. Replacement of 0·5% of tryptone by 0·5% of Na caseinate helped in the detection of acid production and protein hydrolysis by colonies, while omission of the agar gave an excellent broth medium for all types of lactic acid bacteria. S. C. Jolly.

Maltol and hydroxymethylfurfural in evaporated milk as shown by paper chromatography. F. E. Potter and S. Patton (*J. Dairy Sci.*, 1956, **39**, 978—982).—Maltol and hydroxymethylfurfural were detected by paper chromatography in retail samples of evaporated milk as well as in milk subjected to more severe heat treatment (120° for 2 hr.). Neither compound was detected in milk heated at 65·6° for 20 min. S. C. Jolly.

Lactose crystallization in ice cream. II. Factors affecting rate and quantity. T. A. Nickerson (*J. Dairy Sci.*, 1956, **39**, 1342—1350).—At −10°F. neither lactose content, presence of nuclei nor mutarotation is the controlling factor in rate of crystallization of lactose in ice cream; between −10° and +2°F. is a critical temp. zone. At +2°F. crystallization rate is limited by the development of crystal nuclei. At this temp. and above, crystallization occurs as rapidly as mutarotation allows, once crystal nuclei are present. S. C. Jolly.

Washed and unwashed butter. II. Chemical factors. R. R. Riel, A. H. White and W. A. McGugan. **III. Microbiological aspects.** A. H. White and K. N. Smith (*J. Dairy Sci.*, 1956, **39**, 1351—1358, 1359—1363).—II. Washing and storage for 6 months at −5°F. had no effect on peroxide and acid degree values of butter. Washing had no effect on Fe content but it increased pH slightly (0·2 unit) and occasionally reduced Cu content slightly. Flavour after storage was correlated with Cu and Fe contents but not with peroxide value, acid degree or pH. Peroxide value was inversely correlated with pH but was not correlated with Cu or Fe content.

III. Non-washing of butter during manufacture was not a significant factor in increasing the content of micro-organisms. Flavour of butter during 10-months storage at −5°F. was not related to bacterial counts, probably because of the absence of flavour-deteriorating micro-organisms. S. C. Jolly.

The unsaturated acids of butter fat. R. H. Backderf (*Dissert. Abstr.*, 1956, **16**, 1338—1339).—As "oleic" acid isolated from butterfat by the usual methods had lower m.p. than pure oleic acid, the C_{18} acids from Ohio summer butterfat were fractionated by repeated crystallization of the Me esters from MeOH at low temp. and then subjected to cleavage analysis (oxidation with $KMnO_4$ in acetic acid or with O_3 and then chromatography of the dicarboxylic acids so obtained) to determine the position of the double bonds and i.r. spectroscopy to ascertain their configuration. A small fraction of esters with solubility between those of Me stearate and Me oleate comprised 25% of the acids with *trans* unsaturation, of which 60% were vaccenic (*trans*-11-octadecenoic) acid and 60% of a new acid *trans*-16-octadecenoic acid (1—2% of total butterfat acids). Vaccenic acid was present in other fractions also, and 1% (on total acids) of *cis*-11-octadecenoic acid and traces of elaidic acid were found with also uncharacterized isomers of linoleic acid. Over 50% of the hexadecenoic acids were *trans*, the *trans*-9-acid (not previously reported) comprising 0·04% of the total fatty acids. Positional isomers of this acid were not found. G. Helms.

Modification of the refractive index method for the detection of foreign fats in dairy products. V. R. Bhalerao and F. A. Kummerow (*J. Dairy Sci.*, 1956, **39**, 947—955).—A method is described for detecting adulteration of butterfat with any foreign fat at the 10% level. The method is based on changes in n of the alcohol-sol. and of iodinated and uniodinated alcohol-insol. fractions. Limitations of other methods, including the butyric acid, sterol acetate and tocopherol tests and other tests based on component fatty acids, are discussed. S. C. Jolly.

Methods for the detection of foreign fats in dairy products. V. R. Bhalerao and F. A. Kummerow (*J. Dairy Sci.*, 1956, **39**, 956—964).—The methods that have been proposed for the detection of foreign fats in dairy products are critically surveyed. S. C. Jolly.

Phospholipases, especially those of vegetable origin. L. Acker (*Angew. Chem.*, 1956, **68**, 560—565).—A report on methods of proving the presence of phospholipases in plants, on their importance for the dairying industry and on the storage of lecithin-containing foodstuffs. (64 references.) M. Davis.

Phospholipins in dairy products. B. B. Baliga and K. P. Basu (*Indian J. Dairy Sci.*, 1956, **9**, 95—103).—A previously reported method (cf. J.S.F.A. Abstr., 1956, i, 169) for the estimation of lecithin, cephalin and sphingomyelin in milk was applied to similar estimations in cream, butter, ghee and buttermilk; modifications of technique are described. In the cream of both cow and buffalo milk, the phospholipin content increased as the fat content increased; the ratio of lecithin : cephalin : sphingomyelin was about the same as in the corresponding milks, viz., 30 : 45 : 25. Total phospholipins in cream ranged from 153·2 to 278·9 mg. per 100 g. (fat 33·6 to 51·0%) for cows' milk, 122·9 to 234·5 mg. (fat 47·4 to 57·6%) for buffalo milk, and, e.g., in creamery butter 74·85 to 217·56 mg.; in ghee from *desi* butter 20 to 65·22 mg., and buffalo buttermilk 16·29 to 28·79 mg., etc. (10 references.) G. Helms.

Isolation and identification of acidic and neutral carbonyl compounds in various cheese varieties. E. W. Bassett (*Dissert. Abstr.*, 1956, **16**, 1425—1426).—The acidic and neutral carbonyl compounds in 82 samples of different varieties of cheese were separated and identified by paper chromatography of the 2 : 4-dinitrophenylhydrazones supplemented by the usual techniques, viz. R_F values, light absorption analysis, decarboxylation of β-keto-acids and rechromatography on the neutral CO compounds and m.p. determinations. The kind and relative concn. of acidic and neutral CO compounds were a definite characteristic of each type of cheese, and could not be related to age or characteristic flavour of the cheese. From the acidic CO compounds found, the cheeses were classified into three groups according to the type of fermentation occurring during the ripening process; the classes were (1) Swiss, brick, and Cheddar, (2) Romano, Provolone, and blue cheeses, and (3) Camembert and Limburger. The keto-acids and neutral CO compounds in each of the eight varieties of cheese are enumerated. G. Helms.

Methods of prevention of blueing in the cheese factory of soft Camembert type pastes. J. Jacquet (*C. R. Acad. Sci., Paris*, 1956, **243**, 1568—1570).—The "blueing" of Camembert cheese is due to contamination by *Penicillium glaucum* which develops in preference to the organism seeded (*P. caseicolum*). The conditions of pH, salinity, etc. which favour one organism as against the other are examined in detail and recommendations are made accordingly. J. S. C.

Biochemistry of cheese ripening. XIX. Determination and characterization of prolidase in sour milk cheese. J. Schormüller and H. Müller (*Z. LebensmittUntersuch.*, 1957, **105**, 39—51).—The synthesis of proline peptide is described and characteristics are examined by paper chromatography. A process for the determination of prolidase in sour milk cheese was worked out. The enzyme has an optimum pH of 7·75, is relatively heat sensitive, is activated considerably by Mn and inhibited strongly by Ag^{+} and Hg^{++} and org. Hg compounds. It is inhibited strongly by Cd^{++} and this forms a demarcation from prolinase of sour milk cheese, this latter enzyme being activated strongly by Cd^{++}. In normal cheese the prolidase increases to the end of the ripening stage and decreases after about 11 days. The prolidase activity of sour milk cheese possesses essential significance for the proteolytic breakdown of cheese protein and prolidase has a unique position among other peptidases in cheese ripening. Quick ripening soft cheese, e.g., Camembert and Harz are specially rich in prolidase, Swiss, Edam, etc., essentially poor, and Gervais is practically free from prolidase. E. M. J.

Effects of ozone on chilled meat. I. Decomposition of ozone in presence of meat. G. Kaess (*Aust. J. appl. Sci.*, 1956, **7**, 242—262).—The effect of constant continuous concn. of O_3 on the storage life of chilled meat was studied. In the absence of meat, the slow rate of decomposition of O_3 in glass desiccators at constant temp. (0·3°) and R.H. (99·3 ± 0·2%) indicates a monomol. reaction. A mean initial O_3 concn. of ~20 mg./cu. m. with exposure times of 4—22 hr. was used, but the effects of other initial concn. between 5 and 160 mg. were also studied. The presence of slices of lean beef (1 mm. thick) greatly increased the rate of decomposition of

O_3, the rate constant following the monomol. law of Ewell (*Refrig. Engng*, 1933, **26**, 68). With a constant O_3 concn. of ~20 mg./cu. m., the log. of the rate of reaction with the meat decreases linearly with time (4·8—140 hr.) of pre-ozonization of the meat slices. The kinetics of the process are analysed fully from the experimental data. W. J. BAKER.

Regeneration and stability of oxymyoglobin in some γ-irradiated meats. A. L. Tappel (*Food Res.*, 1956, **21**, 650—655).—Observations on the regeneration of oxymyoglobin by γ-irradiation of meat containing metmyoglobin are recorded. Oxymyoglobin was stable to irradiation up to 8 megarep and to storage after irradiation. A mechanism is proposed involving the reaction of metmyoglobin with free radicals in the regeneration of oxymyoglobin. Irradiation of purified metmyoglobin in aq. solution produced some oxymyoglobin. (17 references.) E. M. J.

Sulphides released from γ-irradiated meat as estimated by condensation with *NN*-dimethyl-*p*-phenylenediamine. E. P. Marbach and D. M. Doty (*J. agric. Food Chem.*, 1956, **4**, 881—884).—The reaction of H_2S with *NN*-dimethyl-*p*-phenylenediamine to form methylene blue is adapted for the colorimetric determination of small quantities of sulphides from γ-irradiated meat. The vapours are carried with a stream of N_2 into a trapping tube containing $Cd(OH)_2$ and NaOH. The colour is developed by adding a mixture of acid amine solution and Reissner's solution to this mixture. The intensity of developed colour is measured at 665 mμ. The method can be used for the quant. determination of 2—16 p.p.m. H_2S. (10 references.) N. M. WALLER.

Chromatographic separation of a porphyrin produced from myoglobin by γ-irradiation. I. D. Ginger and B. S. Schweigert (*J. agric. Food Chem.*, 1956, **4**, 885—886).—Myoglobin in beef muscle is changed to a green pigment when irradiated in a ^{60}Co source with a total dosage of $1·3 \times 10^6$ rep. Prep. showing this green colour were cleared by acid-acetone treatment and the resultant hæmin components successfully separated by paper chromatography. Spectral data on these components suggest that the altered compound is an oxidation product of the hæm moiety of myoglobin. N. M. WALLER.

Freeze-dried meat. III. Non-oxidative deterioration of freeze-dried beef. IV. Factors affecting the rate of deterioration. L. W. Regier and A. L. Tappel (*Food Res.*, 1956, **21**, 630—639, 640—649).—III. The chief physical and chemical changes which occur during the storage of freeze-dried beef are defined and possible reaction mechanisms are analysed. Active carbonylamine browning is the main and probably the only significant non-oxidative deteriorative reaction. (21 references.)

IV. The quant. effects of temp., water content, pH, concn. of carbonyl compounds and the presence of inhibitors on the browning deterioration of freeze-dried beef are reported. The apparent activation energy for the deterioration during storage is 25 kg.-cal./mol. Thermal denaturation is insignificant. Carbonyl compounds are the limiting reactants in the browning of freeze-dried beef. Decrease in pH causes decrease in the rate of deterioration. Rate of deterioration is increased with increasing moisture level. Possible methods for increasing storage life are discussed. (23 references.) E. M. J.

Measurement of fresh beef muscle colour changes by disc colorimetry. M. M. Voegeli (*Dissert. Abstr.*, 1956, **16**, 1309).—A method for the objective measurement of beef colour and the effect of various treatments on beef colour changes are described. Colour measurements are made in a matching booth under constant illumination by using Munsell discs of known colour notation whereby it is possible to calculate the Munsell hue value and chroma of the meat sample. Colour changes occur most rapidly during the first 2 hr. of storage; subsequent slower changes are governed by the conditions of storage. Samples wrapped in Cellophane maintained a saleable colour longer than did unwrapped samples. Allowing a blooming period before wrapping offered no advantage over immediate wrapping of cut meat. The source, but not the intensity, of light affected the rate of colour change. Freezing and thawing of rib portions reduced the saleable life period of subsequently cut and wrapped samples whereas ageing of rib portions did not affect the rate of colour change. G. HELMS.

Post mortem changes in the interactions of cations and proteins of beef and their relation to sex and diethylstilbœstrol treatment. N. Arnold, E. Wierbicki and F. E. Deatherage (*Food Technol.*, 1956, **10**, 245—250).—In the post mortem ageing process of beef, Na^+ and Ca^{++} were continuously released by the muscle proteins, K^+ was absorbed after the first 24 hr., Mg^{++} was released during the first 24 hr., and between 6—13 days. There was a movement of cations on to the meat proteins resulting in increased charge, greater hydration and increased tenderness. No relation between cationic changes and sex or diethylstilbœstrol treatment of the animal was found. (12 references.) E. M. J.

Development of a scale for grading toughness-tenderness in beef. E. L. Raffensperger, D. R. Peryam and K. R. Wood (*Food Technol.*, 1956, **10**, 627—630). E. M. J.

Determination of fat in mutton carcasses by measurement of specific gravity. R. A. Barton and A. H. Kirton (*Nature, Lond.*, 1956, **178**, 920).—Investigations carried out on groups of pasture-fed ewes show that the relationship between sp. gr. of the whole carcass and the % fat content of the half-carcass and joints is high and that the sp. gr. method of estimating % fat content can be applied in the case of sheep. J. S. C.

Deterioration of dehydrated meat during storage. I. Non-enzymic deterioration in absence of oxygen at tropical temperatures. II. Effect of pH and temperature on browning changes in dehydrated aqueous extracts. J. G. Sharp (*J. Sci. Food Agric.*, 1957, **8**, 14—20, 21—25).—I. Deterioration in quality in precooked, dehydrated pork on storage in absence of O_2 is caused by a typical carbonyl-amino browning reaction. Effects of moisture content and temp. on the changes are discussed. The reactive sugar fraction in meat consists of glucose and glucose-6-phosphate. After storage at 50° in N_2 containing 500 p.p.m. of SO_2 the meat had an unpalatable sulphurous flavour, but no brown colour developed in samples containing only a trace of reducing sugar. The protein residue reacted with glucose to give a tasteless brown product. The development of brown discoloration and typical burnt flavours occurred only in samples containing both reducing sugar and the aq. sol. substances of the meat. If the sugars were removed by fermentation, or the glucose was inactivated by treatment with glucose oxidase there was appreciable reduction in browning deterioration in N_2 at 50°. (26 references.)

II. In dehydrated protein-free aq. extracts of pork, in N_2, the rate of development of brown discoloration at 37° over the range pH 3—7 increases with pH. The Q_{10} of the rates of loss of free fermentable sugar and development of brown discoloration over the range 15—50° are the same and lie between 3·2 and 4·3. E. M. J.

Methods of appraising swine carcass quality. L. M. Winters, W. E. Rempel and A. Dettmers (*A. R. Hormel Inst.*, 1955—56, 72—74).—Percentages of fat, lean and bone in complete swine carcasses and the five primal cuts of pork calculated from formulæ derived previously compared favourably with % obtained by actual separation of the tissues. About 42% each of lean and fat is probably the optimum for pork. S. C. JOLLY.

Quality of smoked ham as affected by adding antibiotic and fat to the diet and phosphate to the cure. I. Cooking losses, palatability, separable fat and sheer values. P. Mahon, D. Hogue, P. Leeking, E. Lim and F. Fenton. **II. Objective colour.** F. Fenton, B. E. Sheffy, H. D. Naumann, G. H. Wellington, D. Hogue and P. Mahon. **III. Moisture, fat, chloride and thiamine content.** P. Leeking, P. Mahon, D. Hogue, E. Lim and F. Fenton (*Food Technol.*, 1956, **10**, 270—272, 272—274, 274—276).—I. Under the conditions studied, neither the effect of adding an antibiotic and/or animal fat to the diet of pigs, nor Na_2HPO_4 in curing, resulted in appreciable differences in the qualities of the smoked hams. (30 references.)

II. In tests on 62 smoked hams before and after roasting colour was determined with a Hunter Colour and Colour-Difference Meter and reported as a/b ratio or hue. There were no significant differences in the a/b values of the lean meat of uncooked or cooked hams which could be attributed to the diets of the pigs, to the curing of the hams, or to interaction between diets and cures. There was a highly significant difference in the a/b values of lean ham from pig to pig within diet. (19 references.)

III. Under the conditions tested, moisture, fat, chloride and thiamine contents of either the uncooked or roasted hams were not appreciably affected by the diet or by the cure treatments. (14 references.) E. M. J.

Practical aspects of bacon factory processing. J. F. Evans (*Chem. & Ind.*, 1956, 861—863).—Developments in bacon factory design and processing, curing, utilization of by-products, factory hygiene and conditions are reviewed. J. S. C.

Consumer preference in bacon. T. Johnston (*Chem. & Ind.*, 1956, 864—866).—A review of recent changes in consumer tastes for bacon and ham and their influence on developments in the industry. J. S. C.

Industries for treatment of fishery products. Salting, smoking, drying and semi-preserves. D. Remy (*Industr. agric. aliment.*, 1956, **73**, 799—806).—A general review of French practices. J. S. C.

Influence of freezing rate on denaturation of cold-stored fish. R. M. Love (*Nature, Lond.*, 1956, **178**, 988—989).—Denaturation in relation to the disposition of the ice in fillets of North Sea cod (*Gadus callarias*) was investigated by a technique which utilizes the amount of deoxyribose nucleic acid in the intercellular fluid as a measure of cell damage (cf. J.S.F.A. Abstr., 1955, i, 324; ii, 120).

Denaturation was assessed from the % muscle proteins sol. in neutral 5% aq. NaCl. The overall extent of denaturation depended on length of storage but large differences existed between fish frozen at different rates. Where high-speed freezing produced small intracellular ice columns, denaturation was relatively low and it increased steadily with slower freezing to a max. at the point where the largest possible intracellular ice columns formed, the proteins being then compressed into narrow strips along the cell margins. Beyond this point, cell bursting occurred and denaturation decreased, reaching a min. at the point where all ice was intercellular and fibre rupture ceased. J. S. C.

Rapid vacuum distillation procedure for the determination of volatile acids and volatile bases in fish flesh. Tetuo Tomiyama, A. A. da Costa and J. A. Stern (*Food Technol.*, 1956, **10**, 614—617).—The method described is rapid, without loss of accuracy or precision; a stable extract of flesh is prepared by treatment with $MgSO_4$ solution and used for both determinations. E. M. J.

Dehydration of fish available in Bengal. K. C. Saha, A. Deb, D. P. Sen and B. C. Guha (*J. Indian chem. Soc., Industr. Edn*, 1956, **19**, 117—130).—Dehydration is successful with fishes of low fat content, but not wholly satisfactory when the fat content is high (e.g., 35—40% on moisture-free basis as with Hilsa fish). Fat removal by previous treatment (steaming) before dehydration increases the preservation time to 2—4 months at best but with high taste deterioration. A method of prep. of salted dehydrated fish is described. Salting greatly improves the taste and flavour without affecting keeping qualities. Dehydration without pre-cooking is not practicable as reconstitution is difficult and gives material of fibrous texture, deep brown colour and with a smell of charring. Preservation is below eight months even with an inert N_2 atmosphere and at 0°, but is better when a CO_2 atmosphere at 0° is used. Air at room temp. gives a keeping time <6 months which is increased to eight months at 0°. Nutritional investigations show a high loss of body fat on dehydration and a slight decrease in ash content. I. Jones.

Deterioration of cooked southern oysters. E. A. Gardner and B. M. Watts (*Food Technol.*, 1957, **11**, 6—11).—Spoilage in oysters (giving a strong qual. test with 3% H_2O_2) cooked enough to inactivate catalase and subsequently frozen was oxidative in type resulting in "rancid" fish odour. Total wt. losses ranged from 17—59 in cooked, and 10—12% in uncooked oysters, respectively, stored at 41°F. (25 references.) E. M. J.

Objective tests applicable to quality studies of ice-stored shrimp. M. E. Bailey, E. A. Fieger and A. F. Novak (*Food Res.*, 1956, **21**, 611—619).—Useful tests (chemical, physical and biological) for determining the relative quality of ice-stored shrimp are reviewed. Tentatively, shrimp at pH <7·7 can be considered as prime quality, at pH between 7·7 and 7·95 as poor, but acceptable, and at pH >7·95 either spoiled or near spoilage. A trimethylamine N value of 1·5 mg./100 g. of shrimp tissue and a bacterial count of 10×10^6 per g. of headless, shell-on shrimp are indicative of an unacceptable product. (31 references.) E. M. J.

Absorbability of natural and modified fats. D. H. Calloway, G. W. Kurtz, J. J. McMullen and L. V. Thomas (*Food Res.*, 1956, **21**, 621—629).—Factors affecting the digestibility of fats are discussed in providing basic information for the development of fats to meet the Armed Forces' (U.S.A.) stability requirement of 160°F. Lipin materials formed by interesterification with hexahydric alcohols were examined. The monoglyceride of hydrogenated lard was more digestible than the original triglyceride. Digestibility is primarily dependent on the amounts and chain length of the saturated fatty acids and their arrangements within the glyceride structure. (12 references.) E. M. J.

Novel method for refining soya-bean oil. L. P. Hayes and H. Wolff (*J. Amer. Oil chem. Soc.*, 1956, **33**, 440—442).—A process for degumming and producing a break-free soya-bean oil comprises stirring the oil (at 60°) with 0·1% org. acid anhydride, then adding 1·5% H_2O, stirring for 30 min. at 40° and centrifuging to remove the aq. layer. The break-free oil as such can be used for industrial purposes, or can be processed into edible oil by steam deodorization for 2 hr. at 240° and 1—2 mm. Hg. pressure, without being alkali-refined. Org. acids are less effective than the anhydrides. Laboratory data relating to the quality of the oils, processing losses and composition of deodorizer distillate are given in comparison with corresponding data for alkali-refined oils. The properties of the lecithin recovered by the degumming process are compared with those of conventionally-prepared lecithin. The process is applicable to groundnut oil but not to cottonseed or maize oil, both of which yielded a dark-coloured degummed oil that did not respond satisfactorily to bleaching with clays and carbons. G. Helms.

Phospholipins in foods: some current problems in the chemistry of animal phosphatides. N. J. Hawthorne (*Chem. & Ind.*, 1956, 1171—1174).—A review of the literature, including chromatographic and other separation techniques, and work on polyunsaturated fatty acids, acetal phosphatides, sphingomyelin, enzyme studies, and inositol phosphatides. (41 references.) J. S. C.

Phospholipins in foods: introduction to the general chemistry of phospholipins. T. Malkin (*Chem. & Ind.*, 1956, 1186—1189).—A general review of the more recent literature. (22 references.) J. S. C.

Phosphilopins in foods: plant phospholipins. F. F. Aylward (*Chem. & Ind.*, 1956, 1360—1366).—A review of the literature dealing with % of phospholipins in plants, occurrence of phospholipin complexes in tissues with carbohydrates and proteins, fatty acids of plant phospholipins, phosphatidic acid and phosphatidyl esters, and inositol compounds. (82 references.) J. S. C.

Quality retention in baby foods processed by high-temperature–short-time methods. G. E. Livingston, W. B. Esselen, E. Feliciotti, D. E. Westcott and M. P. Baldauf (*Food Technol.*, 1957, **11**, 1—5).—Quality evaluation (measurement of vac., pH, η, colour, determination of vitamins B_1, C and carotene contents and taste) of strained foods after packing and storing indicated that products processed by high-temp.–short-time methods had better colour and thiamine retention and initially higher pH than control samples. E. M. J.

Assay methods for determination of protein quality. I. Growth response of the confused flour beetle (*Tribolium confusum* Duval) and the German cockroach (*Blatella germanica* L.) on six nutritionally different and carefully tested proteins. J. J. Pisano (*Dissert. Abstr.*, 1956, **16**, 1334—1335).—I. A complete purified diet with 18 or 24% of protein (casein, beef, whole egg, egg albumin, groundnut flour) was fed to nymphs of the cockroach and larvæ of the flour beetle. Responses determined from wt., age at maturity and survival showed good general agreement. For the larvæ on both diets, whole egg and egg albumin were very poor and beef and casein were good, but at 24% protein response was best with groundnut flour. For the cockroaches, egg albumin was the best and whole egg the poorest. The superiority of the flour beetle larvæ over cockroach nymphs as assay organisms for the biological evaluation of proteins is discussed.

II. Data submitted show that sodium lauryl sulphate (SLS) is an effective protein extractant for plants, 98% of the N being extracted after 1 hour's agitation at 20° in a number of cases. 1% SLS was in all cases more effective than Na_2CO_3 buffer (pH 10·3) alone, 0·2% bisulphite alone, or buffer plus bisulphite; and SLS was equally as effective at pH 2·8 as at pH 10·3. Of the protein extracted from soya-bean, 90—95% was precipitatable with trichloroacetic acid, perfluoro-octanoic acid. G. Helms.

Influence of phytic acid on peptic digestion of different proteins. M. R. Barré (*Ann. pharm. franç.*, 1956, **14**, 182—193).—The rate of hydrolysis of purified almond globulin, white of egg, blood serum, edestin and ovalbumin in acid solution (pH 2·5) with pepsin, with and without phytic acid is investigated, by Kjeldahl and biuret reactions and u.v. absorption. The hydrolysis is inhibited by phytic acid, owing to the formation of an insol. complex with the proteins below their isoelectric point. The formation of this compound is used as a new method of estimating proteases. After hydrolysis under the required conditions, the unhydrolysed or insufficiently hydrolysed substrate is precipitated with phytic acid at pH ~2·5, and the ppt., redissolved in alkaline solution, is estimated by the biuret reaction. E. J. H. Birch.

Paper-disc electrophoresis: new device for separation of serum proteins. N. C. Ganguli (*Analyt. Chem.*, 1956, **28**, 1499—1501).—The simple apparatus shown, constructed of petri dishes (20—16 cm. diam.), is capable of separating the protein from up to 12 samples of serum in one run of 4 hr. duration. The solutions are applied at about 1% concn. and the current is 8—10 ma. E. G. Cummins.

Non-enzymic browning: reaction between D-glucose and glycine in "dry" state. E. L. Richards (*Biochem. J.*, 1956, **64**, 639—644).—The reaction between D-glucose and glycine in the "dry" state at 37°, pH 6·7, and 70% R.H. is studied chromatographically and spectroscopically. A true intermediate in the browning reaction is the enolic form of *N*-(carboxymethyl)amino-1-deoxyfructose. J. N. Ashley.

Microbiological detection of amino-acids. H. Haenel and W. Müller Beuthow (*Ernährungsforschung*, 1956, **1**, 553—558).—The microbiological technique for the determination of amino-acids is surveyed. Of four methods discussed that of Nehring is recommended for the break down of protein, viz., a short-time hydrolysis (2N-HCl, 2 hr. at 135°). Comparison of 10 amino-acids derived

respectively from raw casein, alcohol-extracted casein, and lact-albumin indicated that the amount of cystine in lactalbumin was 5-fold higher than that in casein. E. M. J.

Determination of partition coefficients of carotenoids as a tool in pigment analysis. F. J. Petracek and L. Zechmeister (*Analyt. Chem.*, 1956, **28**, 1484—1485).—A photometric method for the estimation of partition coefficients which facilitates the identification of carotenoid pigments is described. Results for the hexane–85% methanol system are tabulated. E. G. CUMMINS.

Effect of ionizing radiations on carotenoid stability. A. Lukton and G. Mackinney (*Food Technol.*, 1956, **10**, 630—632).—The destruction of carotenoid pigments on exposure to γ-radiation (from a ^{60}Co source) is caused by secondary reactions and depends on available free radicals or peroxides formed in the surrounding medium. Of three carotenoid-containing oils tested, carrot oil had the highest followed by maize oil and salmon oil the lowest stability. Conditions of stability are discussed. E. M. J.

Extraction and utilization of carotenes and xanthophylls. E. M. Burdick (*Econ. Bot.* 1956, **22**, 267—279).—Commercial carotenes include α-, β-, γ- and δ-carotene and commercial xanthophylls, lutein, bixin, zeaxanthin, cryptoxanthin, crocetin and capsanthin. The sources and properties of these are given, together with their values vitamin-A precursors. Methods of extraction are described. L. G. G. WARNE.

Microbiological assay of inositol with a strain of *Schizosaccharomyces pombe*. F. W. Norris and A. Darbre (*Analyst*, 1956, **81**, 394—400).—The microbiological assay of total and free inositol by a tube method is described. The basal medium is that described by Northam *et al.* (*J. gen. Microbiol.*, 1952, **7**, 245) with the omission of asparagine and a twofold increase in biotin content. The procedure for the extraction of total inositol and free inositol and for the preparation of the inoculum are described. Sample and standard tubes containing the basa medium are sterilized, inoculated and incubated at 25° ± 0·2° for 72 hr. The turbidities are measured in a Spekker absorptiometer against the medium as blank. Results with germinating soya-bean flour are used to illustrate the method of computation. The free and total inositol contents of a number of food and other materials are given. A. O. JONES.

Determination and occurrence of vitamin B_{12}. H. Haenel (*Ernährungsforschung*, 1956, **1**, 526—532).—The microbiological methods of detection of vitamin B_{12} are reviewed. Proportions occurring in common plant products, e.g., beer yeast, seaweed meal, white cabbage, edible fungi, fruit juices of currants, etc., are listed. (10 references.) E. M. J.

Paper ionophoresis of some purines and pyrimidines. S. N. Mukherjee and A. R. Ghosh (*J. Indian chem. Soc.*, 1956, **33**, 573—578).—Paper ionophoresis of the common purines and pyrimidines of nucleic acids has been carried out in presence of acid, of alkali, and of a phosphate buffer of pH 2·2, both horizontally and vertically. The results are reproducible if evaporation is prevented. O. M. WHITTON.

Instrument for measuring the breaking strength of jellies. I. G. Rieckehoff (*J. agric. Puerto Rico*, 1956, **40**, 93—100).—The instrument consists of a torsional viscometer with a special attachment which lowers the rotating spindle at a uniform rate into the jelly. The drag produced upon the spindle rotating at a definite speed is recorded. A. H. CORNFIELD.

Using glycerin with water-soluble gums. J. B. Segur, E. L. Whittaker and C. S. Miner, jun. (*Food Technol.*, 1956, **10**, 625—626).—As a wetting-out liquid applied to a gum before the addition of water, glycerin aids dispersion of the gum by reducing the formation of lumps. The η of gum–glycerin–water solutions; and penetration and freezing tests of gum–glycerin–water gels are recorded. E. M. J.

Microbiological analysis with fungi (Neurospora, Phycomyces). H. Haenel and W. Müller Beuthow (*Ernährungsforschung*, 1956, **1**, 541—552).—A survey is given of the suitability of fungi of the genera Neurospora and Phycomyces for routine determinations of vitamins of the B-complex. The "germination-ring" technique and further developments including this test combined with paper chromatography, additions of biotin or thiamine, the establishment of an inhibition index by butylpyrithiamine against thiamine and the suitability of antivitamins, e.g., butylpyrithiamine or sublimate solution for the detection of vitamins are described. E. M. J.

Effect of iron, zinc, manganese and calcium on the growth of various strains of *Streptomyces* A. H. Heim and H. Lechevalier (*Mycologia*, 1956, **48**, 628—636).—When added alone none of the metals tested except iron increased growth of the eight strains of *Streptomyces* used. Zn alone had no effect but Zn plus Fe had a much greater effect than Fe alone. L. G. G. WARNE.

Composition of volatile oil of black pepper, *Piper nigrum*. T. Hasselstrom, E. J. Hewitt, K. S. Konigsbacher and J. J. Ritter (*J. agric. Food Chem.*, 1957, **5**, 53—55).—Compounds isolated from pepper oil and pertinent characterization data are given. The oil derives its characteristic odour from small amounts of oxygenated terpenes, of which piperonal, dihydrocarveol, caryophyllene oxide, cryptone and an alcohol $C_{10}H_{18}O$ were isolated and identified. (29 references.) E. M. J.

Preservative action of acid substances in food. *M. Ingram, F. J. H. Ottaway and J. B. M. Coppock (Chem. & Ind., 1956, 1154—1163).*—The effects of pH and dissociation of acids on the growth of microbes are considered and the bacteriostatic and fungicidal properties are reviewed of benzoic acid and its deriv., vanillic acid esters, acetic acid and acetates, monochloroacetic acid, propionic acid and propionates, dehydroacetic acid, sorbic acid, and other org. acids and salts, SO_2 and sulphites, boric and borates, acid Ca phosphate and nitrites. The use of preservatives in baked products and their potential value in bread are also discussed. (87 references.) J. S. C.

High radiopasteurization as a new food process combining γ-radiation and refrigeration. L. E. Brownell and S. N. Purohit (*Refrig. Engng*, 1956, **64**, No. 6, 39—49, 98).—A process combining high γ-radiation and refrigeration is described. Its object is to increase storage life of cooked meats, blanched vegetables and other foods packed in plastic bags. (13 references.) J. S. C.

Effects of packing procedure on container performance in canned apple sauce. G. G. Kohn and J. E. Fix (*Food Technol.*, 1956, **10**, 610—613).—The detinning occurring in the larger cans of apple sauce whether the cans are made from electrolytic or hot-dipped tinplate can be controlled by reducing the head space to a min. by removing the head-space air. E. M. J.

Underground storage of grain. D. W. Hall, G. A. Haswell and T. A. Oxley (*Colonial Research Studies H.M.S.O.*, 1956, No. 21, 27 pp.).—A review of the principles involved in the construction of airtight grain-storage pits and of the problems encountered in their siting, design and construction. (10 references.) J. S. C.

Packaged popcorn kernels. Rose Kist Foods, Inc. (Inventor: J. T. Martin) (B.P. 747,022, 18.6.53).—Popcorn kernels are packed into a container which is filled completely with a mixture containing 30—50% hydrogenated soya-bean oil and 70—50% refined groundnut oil, to facilitate introduction of the corn into the corn popper and to prevent loss of moisture during storage of the kernels. J. S. C.

Food products containing food adjuncts. Monkhouse & Glasscock, Ltd. (Inventors: G. S. Morrison and R. J. L. Allen) (B.P. 745,384, 6.3.53).—Dry powder or granular food product (jelly crystals, lemonade powder, custard powder, etc.) is compounded with sweetening agent and flavouring made in the form of solid, highly flavoured solid fondant, to provide a composition which when admixed with water or milk is converted into a uniformly flavoured comestible. Thus, a mixture of water (14), glucose (14), and granulated sugar (56 pt.) is kept at 95° until homogeneous, then heated to 119°, and cooled to 55°. The resulting syrup is vigorously stirred to produce an opaque fondant. For further treatment it is melted, admixed (112 lb.) with strawberry essence (35·25 fl. oz.) containing conc. natural fruit juices (~95) and flavouring esters (5 vol.-%), poured into a rubber mould, and cooled to room temp. The resulting flavoured fondant is subsequently incorporated in finely-divided dry unflavoured sol. food, e.g., jelly crystals. F. R. BASFORD.

3.—SANITATION

Performance of a detergent-sanitizer for milk utensil sanitation in unsupervised field tests. M. L. Speck and H. L. Lucas (*J. Milk Tech.*, 1957, **20**, 3—6).—The product tested contained 35% Na_2CO_3, 5% methyl dodecylbenzyl trimethyl ammonium chloride, and 60% of inert ingredients composed of non-ionic detergent, sequestering and chelating compounds. The concn. used was 1¼ oz. to 10 quarts of water. Comparison of results with those of customary methods indicated that the thermoduric content of milk was lowered and cleaner utensils with no milk-stone deposition were obtained. J. S. C.

Cleaning and sterilising in the dairy industry. J. G. Davis (*Dairy Sci. Abstr.*, 1956, **18**, 530—553).—A review of the literature 1940—1955. (About 200 references.) A. G. POLLARD.

Determination of the vapour pressure of ethylene dibromide. F. Call (*J. Sci. Food Agric.*, 1957, **8**, 81—85).—The determination of the vapour pressure of ethylene dibromide by the static and dynamic methods over a temp. range of 0—25° is described. E. M. J.

Diffusion of ethylene dibromide vapour in air. F. Call (*J. Sci. Food Agric.*, 1957, **8**, 86—89).—The diffusion coeff. of ethylene dibromide vapour in air was calculated at temp. 0—20° from accumulated data. The effects of moisture and CO_2 are small but definite. In the upper 12—15 in. of normal field soils with a CO_2 content of 1—4%, the diffusion coeff. is reduced by between 1 and 2%. E. M. J.

Comparative synergistic effects of synthetic 3 : 4-methylenedioxyphenoxy compounds in pyrethrin and allethrin fly sprays. W. A. Gersdorff, P. G. Piquett and M. Beroza (*J. agric. Food Chem.*, 1956, **4**, 858—862).—The comparative values of 63 compounds, as synergists with either pyrethrins or allethrin, were determined in tests against the housefly. Of these 43 compounds showed activity and for 18 compounds the intensity of synergism was high, the toxicity of the mixtures being six times that expected for pyrethrins alone or three times that for allethrin. (12 references.) N. M. Waller.

The crystalline isomer of allethrin as a standard of comparison for fly sprays. W. A. Gersdorff, P. G. Piquett and N. Mitlin (*J. econ. Ent.*, 1956, **49**, 450—453).—When applied as contact insecticides in kerosene to house flies, the α-DL-*trans*-isomer of allethrin was 0·29 as toxic as allethrin and 0·74 as toxic as pyrethrins. Biometrically this isomer was no better than purified allethrin when substituted for pyrethrins as a standard of comparison in bioassays. Storage for 38 months did not affect the knockdown value or toxicity of the crystalline isomer or its kerosene solution. A. A. Marsden.

Insecticide resistance in house flies of Japan and Okinawa. G. W. Byers, C. M. Wheeler and T. E. Blakeslee (*J. econ. Ent.*, 1956, **49**, 556—557).—The susceptibilities of four strains of adult house flies from Japan and one strain from Okinawa to DDT, lindane, dieldrin and malathion were determined by topical application. All strains were fairly resistant to DDT and highly susceptible to dieldrin and malathion. House flies which had previously been exposed to lindane or $C_6H_6Cl_6$ in the field for < one year were approx. 10 times as resistant to lindane as were previously unexposed strains. A. A. Marsden.

Pentachloro*cyclo*hexene, an intermediate in the metabolism of lindane by house flies. J. Sternburg and C. W. Kearns (*J. econ. Ent.*, 1956, **49**, 548—552).—Spectrophotometric, chromatographic and colorimetric analyses showed that pentachloro*cyclo*hexene was an intermediate product in the metabolism of lindane in house flies. Both susceptible and lindane-tolerant house flies metabolized lindane, the latter strain doing so at an increased rate. The rate of absorption of lindane from topical application was approx. the same for both strains. A. A. Marsden.

Purification of DDT-dehydrochlorinase from resistant house flies. H. H. Moorefield (*Contr. Boyce Thompson Inst.*, 1956, **18**, 303—310).—Adult insects were powdered in acetone, filtered and the powder dried under vacuum. Aliquot proportions of the powders were slurried in cold, de-ionized water, filtered, and purified by pptn. with $(NH_4)_2SO_4$ followed by dialysis, adsorption with activated charcoal and salt concn. of the resultant protein solution. A simplified procedure based on protection of the enzyme by thiourea followed by elimination of non-specific proteins by a freeze–thaw technique is also discussed. E. G. Brickell.

Resistance of insects to insecticides : biochemical factors in the natural and acquired tolerance of insects to insecticides. F. P. W. Winteringham (*Chem. & Ind.*, 1956, 1182—1186).—The literature on detoxication of DDT by house flies *in vivo* and the mode of action of DDT is reviewed ; data are discussed and presented in an integrated form. (22 references.) J. S. C.

Studies in selective toxicity. III. Benzenesulphonanilides as DDT synergists. M. Neeman, G. G. Mer, R. Cwilich, A. Modiano and S. Zacks (*J. Sci. Food Agric.*, 1957, **8**, 55—64).—Benzenesulphonanilides with halogen or methyl substituents in the phenyl radicals, with or without *N*-alkyl substituents, were assayed as DDT-synergists against DDT-resistant house flies. In the homologous series of *N*-*n*-alkyl-4-chloro- and -4-bromo-benzenesulphon-4′-chloroanilides, the biological response to topical application of dilute toxicant solutions was highest for the *N*-methyl compounds. The "availability" from deposits was highest in the intermediate range C_4 to C_8 and oscillated between homologues having an odd no. and those having an even no. of C atoms. Solubility in kerosene was highest in this range. The possible modes of action and penetration of the benzenesulphonanilide synergists are discussed. (29 references.) E. M. J.

Absorption and metabolism of BHC in susceptible and resistant house flies. F. R. Bradbury (*J. Sci. Food Agric.*, 1957, **8**, 90—96).—Quant. and qual. work on the resistance of houseflies, *Musca domestica*, to γ-BHC is described. BHC isomers were labelled with ^{36}Cl or ^{14}C. Of the α-, β-, γ-, δ- the α- and γ-isomers are more readily converted into water-sol. compounds by house flies than the β- and δ-compounds. Chloride ions corresponding to the removal of 4—6 atoms of Cl were produced from each mol. of BHC metabolized ; 11 water-sol. acidic compounds were found from both α- and γ-BHC which on examination by chromatography and paper electrophoresis were identical or very similar series. Detoxication by metabolism is essential for complete recovery of the insect. The susceptible strain of house fly has exceptional ability to eliminate γ-BHC as water-sol. products. (18 references.) E. M. J.

Comparative tests of effectiveness of DDT and BHC dusting powders against the "hide or leather beetle" *Dermestes Maculatus* Degeer (Col. Dermestidæ). G. C. Williams (*J. Soc. Leath. Tr. Chem.*, 1956, **40**, 253—258).—BHC containing 0·5% γ-isomer products gave complete and rapid knockdown of adult *D. maculutus*, followed by death. DDT (5%) dusting powder is much less rapid. Larvæ are less reactive than adults towards BHC but become moribund in 24 hr. and die in 72 hr. DDT is ineffective against larvæ. The larvæ pick up the BHC whilst walking, and fumigant action does not seem to operate. G. Helms.

Laboratory comparison of eight organic phosphorus insecticides as larvicides against non-resistant house flies. D. A. Lindquist and R. W. Fay (*J. econ. Ent.*, 1956, **49**, 463—465).—Of eight org. P compounds tested in the laboratory as surface applications of xylene emulsions, Diazinon (5 mg. per sq. ft.) was the most effective giving >90% kill of small, medium and large larvæ. In order of decreasing effectiveness the compounds were : Diazinon, EPN, parathion, Bayer 21/199, NPD, demeton, Bayer L13/59 and malathion. In general, these prep. were more effective on small and medium sized larvæ than on large ones ; they were relatively ineffective against fly pupæ. A. A. Marsden.

The synergistic activity of piperonyl butoxide applied at different intervals to pyrethrum-treated house flies. M. S. Blum and C. W. Kearns (*J. econ. Ent.*, 1956, **49**, 496—497).—Piperonyl butoxide (**I**) enhanced the toxicity of pyrethrum when applied after the insecticide. A high ratio of synergist to insecticide produced substantial kills even when the synergist was applied 8 hr. after the insecticide. At similar concn. injected applications of **I** were more efficient than topical applications when the synergist was applied to pyrethrum-treated flies. The ability of a **I**–pyrethrum interaction to produce a good knockdown was frequently followed by high mortality. A. A. Marsden.

Copper content of resistant and susceptible house flies. S. J. Ringel (*J. econ. Ent.*, 1956, **49**, 569—570).—A significant difference in Cu content per unit wt. was found between male and female flies but there was no difference between resistant and susceptible insects. A. A. Marsden.

Comparative effect of DDT-treated houses on introduced *Anopheles quadrimaculatus* adults, 1944 and 1955. G. E. Smith (*J. econ. Ent.*, 1956, **49**, 523—526).—Natural populations of adult *A. quadrimaculatus* still reacted to DDT-treated surfaces in the same manner as after their exposure for 12 years to an area where DDT and related insecticides were used. A. A. Marsden.

Germicidal effects of a quaternary ammonium compound (cetylpyridinium chloride) on *Mycobacterium tuberculosis*. H. W. Ritter (*Appl. Microbiol.*, 1956, **4**, 114—116).—At concn. 1 : 1000 of 50% ethanol, cetylpyridinium chloride effectively sterilized glass contaminated with a virulent human strain of *M. tuberculosis*. A. G. Pollard.

Effect of a quaternary ammonium germicide on electrophoretic mobility of *Escherichia coli* in various salt solutions. D. L. Meggison, jun., and W. S. Mueller (*Appl. Microbiol.*, 1956, **4**, 119—121).—Electrophoretic measurements of *E. coli* suspensions containing neutral salts indicate that the interference of metallic cations in the germicidal action of quaternary NH_4 compounds depends on the capacity of the cation to restrict the action of the quaternary compound in modifying the electrical charge on the surface of bacterial cells. A. G. Pollard.

Toxicity of six chemical compounds to thirty cultures of algæ. T. E. Maloney and C. M. Palmer (*Wat. & Sewage Wks*, 1956, **103**, 509—513).—The compounds evaluated were : $CuSO_4$ (**I**), 2 : 3-dichloronaphthaquinone (**II**), dodecylacetamido-dimethyl-benzylammonium chloride (**III**), rosin amine D-acetate (**IV**), rosin amine D-sulphate (**V**), and Zndimethyl dithiocarbamate (**VI**). Each was tested in 14 concn. of 0·004—32 p.p.m. against 30 spp. of algæ in culture and for toxicity to fish by preliminary bioassay tests. **III** and **IV** appeared to have the best potentialities as general algicides. **VI** was extremely effective in controlling algal growth but highly toxic to fish. **V** was less effective than **IV**. **II** was selectively toxic to some of the blue-green algæ. **I** appeared to be selective rather than general at concn. of 2 p.p.m. or less. (12 references.) J. S. C.

Composting of organic wastes. R. F. McCauley (*Wat. & Sewage Wks*, 1956, **103**, 522—527).—Pilot plant studies of the composting of org. wastes, e.g., garbage and sewage sludge, are described and the results discussed. J. S. C.

Direct utilization of waste waters. R. C. Merz (*Wat. & Sewage Wks*, 1956, **103**, 417—423).—In addition to the recycling of water used in chemical processes, coal-washing, etc., reclaimed sewage effluents are employed as make-up water for cooling towers and boilers, in steel and chemical works and oil refineries, etc., and for irrigation in semi-arid regions. Successful use of reclaimed sewage in agriculture depends on topography, climate, land prep., the pretreatment of the sewage and the crops grown. J. M. JACOBS.

Treatment of wastes from a maize industry by pilot-plant trickling filters. R. Hatfield, E. R. Strong, F. Heinsohn, H. Powell and T. G. Stone (*Sewage industr. Wastes*, 1956, **28**, 1240—1246).—A comparative study was made of a " super-activated sludge treatment " and the trickling filter process for treating wastes from a maize products refining factory. Data obtained in the latter process indicated that satisfactory B.O.D. removal and effluent quality could be obtained at pH 6—8·5, with a constant re-cycle ratio of treated effluent and a B.O.D./N ratio of 20 : 1 and B.O.D./P ratio of 75 : 1 maintained to supply nutrients for the micro-organisms. J. S. C.

Lipin components in anaërobically digesting sewage solids. P. K. Mueller (*Dissert. Abstr.*, 1956, **16**, 1239).—Acidified, chemically dried sewage sludge is extracted with light petroleum and the lipin matter and the fatty acids present fractionated by the scheme described in detail. The fats are hydrolysed to higher fatty acids comprising 90% oleic, palmitic and stearic acids. In unseeded digestion the unsaturated acids are completely hydrogenated in the first 20 days. When conditions are optimum for CH_4 production, the acids are degraded to volatile acids and CO_2 without the production of intermediate acids except myristic. At max. CH_4 production, 70—80% of the total lipin destruction occurs, oleic, palmitic and stearic acids disappearing at the same rate. Unsaponifiable matter is not destroyed in seeded digestion but during high-rate digestion 20—40% destruction occurs. The I val. of the fats is a useful guide for assessing degree of digestion. The results agree with the β-oxidation theory of fatty acids. O. M. WHITTON.

Air diffusers : their history and use in the activated sludge process. E. P. Coombs (*J. Inst. Sewage Purif.*, 1955, 304—313).—The gradual development of air diffusers over a period of 42 years is historically reviewed. J. S. C.

Effects of synthetic detergents on activated sludge. R. M. Manganelli (*Wat. & Sewage Wks*, 1956, **103**, 424—427).—The results of laboratory experiments on the effects of an anionic, a non-anionic, and a cationic surface-active agent on the oxidation of activated sludge at various pH levels, on adsorption phenomena of activated sludge (removal of protein), the nitrification and purification of the sludge, etc., are discussed. The anionic and cationic detergents were capable of affecting the characteristics of the sludge, but the non-ionic surface-active agent (Tween 80) is oxidizable and therefore had no adverse effect. J. M. JACOBS.

Biochemical degradation of synthetic detergents. III. Relationships between biological degradation and froth persistence. R. H. Bogan and C. N. Sawyer (*Sewage industr. Wastes*, 1956, **28**, 637—643).—The frothing of three alkylbenzenesulphonates, three aliphatic sulphonates and three non-ionic polyoxyethylene deriv. all in common use as detergents, in the presence of activated sludge, was studied. Froth persistence was closely related to susceptibility of the detergent to biological degradation. The most persistent foamers were branched structure alkyl–aryl types. The org. solids in raw sewage have an anti-foaming effect by holding the surface-active materials. J. S. C.

Activated sludge process. T. Jaffe (*Wat. & Sewage Wks*, 1956, **103**, 428—434).—Economies in operation are secured by tapered aëration (in which the air supply is adjusted by increasing the diffuser area at the inlet end of the tanks), by the step-aëration process (in which only a portion of the load is introduced at the inlet and the remainder is added in subsequent stages), by reduction of the amount of solids in the sludge returned to the aëration tank, and by stabilization of the sewage by means of two activated sludge systems in series (the excess sludge contains less water, smaller aëration units are required, and adjustment of operation to shock overloads is facilitated). Other improvements include the introduction of paddle-wheel agitation, the use of atm. instead of compressed air, impingement type aërators, dual aëration, etc. J. M. JACOBS.

Chemical methods of determination of atmospheric ozone. Rasool and A. Vassy (*C. R. Acad. Sci., Paris*, 1956, **243**, 298—299).—Chemical and spectrophotometric determinations of O_3 concn. near the ground are compared ; the chemical method gives incorrect and low results when wind velocity is <3 knots. J. S. C.

Human exposures in populated areas during aeroplane application of malathion. P. E. Caplan, D. Culver and W. C. Thielen (*Arch. industr. Hlth.*, 1956, **14**, 326—332).—Air sampling and surface deposit measurement techniques are used to demonstrate the extent of human exposure to malathion applied at 0·46 lb./acre, by aeroplane, to control adult mosquitoes. The average total inspiratory exposure for a man working outdoors was 109·2 μg. and the skin deposit 3556 μg. On the basis of comparison with LD_{50} values for animals, these levels represent no danger. N. M. WALLER.

4.—APPARATUS AND UNCLASSIFIED

Apparatus for determining gas permeability of flexible films. R. Henderson and G. A. Wallace (*Food Technol.*, 1956, **10**, 636—638).—A simple, inexpensive apparatus for determining the gas permeability of flexible packaging films, giving reproducible results, is described. E. M. J.

Semimicro-Kjeldahl determination of nitro and amido nitrogen. I. Selenium catalysts. A. Takeda and J. Senda (*Ber. Ohara Inst.*, 1956, **10**, 241—244).—Satisfactory results in the semimicro determination of nitro- and amido-N by the Kjeldahl method were obtained, using as catalysing mixture (1) 1 g. anhyd. K_2SO_4, 15 mg. metallic Se, 70 mg. yellow HgO, (2) 1 g. anhyd. K_2SO_4, 15 mg. metallic Se, 70 mg. yellow HgO, 20 mg. $CuSO_4,5H_2O$, (3) 1 g. anhyd. K_2SO_4, 15 mg. metallic Se, and 20 mg. $CuSO_4,5H_2O$. Approx. 1 g. of each catalyst is used with a sample containing ~5 mg. N. (14 references.) J. S. C.

Structure of agar-agar gels. V. I. Sharkov and R. K. Boyarskaya (*Dokl. Akad. Nauk SSSR*, 1956, **108**, 99—102).—Agar-agar sols and gels contain a fraction readily hydrolysed by 10% H_2SO_4 at 50—100°, and a more resistant fraction, the content of which falls as the hydrolysis temp. rises from 45 to 80°, and is smaller for sols than for gels. R. TRUSCOE.

Determination and distribution of lead in human tissue and excreta. S. L. Tompsett (*Analyst*, 1956, **81**, 330—339).—In a modification of the method previously described (Brit. Abstr., 1935, A, 1160) the ash of the ignited sample is dissolved in HCl and extracted with ether in presence of sodium diethyldithiocarbamate solution. After removal of ether the org. matter is destroyed, the residue is dissolved in HCl and the extraction procedure is repeated in presence of sodium citrate and KCN. After removing org. matter with H_2SO_4 and H_2O_2 the residual liquid is diluted and treated with ammonium acetate, H_2SO_3, KCN, 10 ml. of CCl_4 and a slight excess of a dithizone reagent. The extinction of the CCl_4 extract is measured at 525 (max. for lead dithizonate) and 620 mμ. (max. for free dithizone). It is then treated with dil. acid and the extinction measurements are repeated. The difference between the extinction before and after reversion indicates the amount of Pb present. The distribution of Pb in human tissues and excreta in both normal and pathogenic subjects is discussed as well as the conditions in which mobilization from the skeleton where it is inert into soft tissue where it is toxic occurs. Removal of excess of Pb in plumbism by means of chelating agents is also discussed. A. O. JONES.

Factors favouring restriction to 1 : 2-glycols of materials coloured by the periodic acid–Schiff reaction. J. F. A. McManus (*Nature, Lond.*, 1956, **178**, 914—915).—Data from recent literature concerning the influence of time, excess of reagent, pH and molarity on periodate oxidation reinforce the belief that materials colouring with Schiff's reagent, presumably aldehydes, which are produced in tissue sections by 5-min. oxidation with 0·5% HIO_4, consist of, or contain, 1 : 2-glycol groups and are presumably carbohydrates. (12 references.) J. S. C.

Food compositions. American Home Products Corp., Assees. of R. M. Tomarelli, J. B. Hassinen, G. T. Durbin, F. W. Bernhart, P. Gyoergy, R. Kuhn and F. Zilliken (B.P. 743,674, 13.4.53. U.S., 19.4 and 22.4.52).—A composition, suitable for use as infant food, comprises nutritive material e.g., (dehydrated) cow's milk and (as growth factor for *Lactobacillus bifidus*) 0·5—5% by wt. of solids of *N*-acetyl-D-glucosamine (**I**) or naturally-occurring material containing **I**-residue(s), e.g., blood group (A, B or O) substance, saliva or pancreas. F. R. BASFORD.

no siesta for leaf-cutters

In the plantations at the fringe of the rain forest, noon is dust red, dark shadowed, heat heavy, languid. *And a man must sleep.* At sun high, from the Caribbean to the Matto Grosso, the green world shimmers and dissolves under a bleached sky, sweltering, silent but for the hum of a billion insects. Macaw and marmoset and spider monkey drowse in the high forest fastnesses; puma and anaconda and yaguarundi brood in the shadows. *And in the plantations a man must sleep.*

But for the parasol ants, the leaf-cutters, disciplined, deliberate and undeterred, there is no siesta. Leaves are life to the ravaging sauva ants, and their hunger is as great as their numbers. For years they have been a feared plague and a source of serious loss in the citrus and cacao plantations of Central and tropic South America, for in a few hours foraging workers from a single nest can defoliate an entire tree.

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