JOURNAL
OF THE
SCIENCE OF FOOD AND AGRICULTURE

Published by the Society of Chemical Industry

Vol

Journal of Applied Chemistry

...ers are appearing in the March, 1955, issue of the *Journal of Applied Chemistry*

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A REVIEW OF METHODS OF LAND CLEARING*

By A. H. BUNTING, J. McBRIDE and R. H. GUNN

IN this paper an attempt is made to present the problems of land clearing in their ecological and agricultural setting. It is based largely on the experience won in the Tanganyika groundnuts scheme from 1947 up to the present time.

Land clearing for agricultural purposes is in itself an agricultural process. The agricultural systems of primitive peoples are frequently based on the periodical regeneration of wild vegetation and the restoration of something approaching the climax equilibria of the factors of plant growth, and it is of some importance to consider the role of land clearing in primitive farming. The considerations which follow are derived from tropical African experience alone.

Land clearing in primitive farming

The greater part of the farming of tropical Africa, whether conducted by Europeans or Africans, is carried out on land which has been cleared at some time from woody vegetation of one sort or another. Trapnell[1] in Northern Rhodesia, Milne[2] and other workers in East Africa, de Schlippe[3] in the Equatorial province of the Sudan, and the workers at Yangambi in the equatorial evergreen forest of the Belgian Congo, are among those who have directed special attention to the significance of the clearing operation in African farming.

In North Eastern Rhodesia and Nyasaland, on elevated, permeable tropical red earths and associated soils, under a rainfall of 35–50 in., and in the tall open woodland known as *miombo* or *msasa* (*Brachystegia–Isoberlinia* mixed deciduous open woodland) the *chitemene* system of clearing is used. The bush is opened in circular areas, which are apparently prevented from approaching each other too closely. Part of the area is felled, or often lopped off at or below breast height, and the debris is spread over the ground. Sometimes a larger area may be partially felled and the debris concentrated on part only of the land, and the debris may be specially piled round the stumps. The debris is then fired, and the burning plays a very important part, since it undoubtedly increases the yield, at least of the first crop. This has been shown to be largely an effect of the heat, since it occurs even when the debris is fired on metal sheets and the ash is removed.[1] It is perhaps a partial sterilization effect, and deserves more detailed study.

Belgian work in the high forest at Yangambi, in the central basin of the Congo near Stanleyville, has led to the evolution of the so-called *couloir* system, in which corridors a hundred or so metres wide, and several hundred metres in length, orientated east to west, are communally opened and used for a succession of four crops in two years. The bush begins to be regenerated in the last crop, and this process is aided by the narrowness of the strip and by coppicing from the stumps left after clearing. Regeneration continues for at least 11 years before the strip is opened again. Significant as this work clearly is, one may perhaps suggest that a closer study of the causes of the decline of fertility, on a leached sandy soil of pH about 4, almost devoid of magnesium, in a region where 80 in. of rainfall occurs in 10 months each year, might conceivably lead to the development of methods by which the clearings could be used for a longer period after opening, thus reducing the undoubtedly heavy labour cost of opening new strips.

de Schlippe, working very much under the influence of Belgian thought, has studied carefully the native practice of clearing and bush fallowing in the 60-in.-rainfall country of the south-western Sudan, on poor, highly laterized ancient red earths and associated soils, but

* Read at a Symposium on ' Large-scale clearing of forests ' (Agriculture Group) on 20 April, 1954; for a report of the Discussion at the meeting see *Chem. & Ind.*, 1954, p. 688.

this work has not extended to the analysis of the reasons for the decline of fertility or the regenerating function of the bush fallow.

The decline of soil fertility

In most areas the labour of clearing is considerable, and land once cleared will be used as long as possible. The periods reported vary from the 2-year opening (carrying 4 crops) of the wet Yangambi sands to 30 years or more in far drier conditions on heavy clays in the eastern Sudan. The density of human population naturally affects the length of the cycle. Though very little work has been done on the reasons for decline in fertility, it is probable that surface wash—an insidious, extensive and generally neglected form of soil erosion—is especially significant. It differs from what might be called conventional erosion in that the main source of erosive energy is the kinetic energy of the raindrops themselves, and not the turbulence of water moving down a slope. Ellison,[4] in the U.S.A., has contributed significantly to the understanding of what he calls ' rainsplash erosion '. For the individual crop the main damage associated with surface wash may lie in the direct loss of water that would otherwise penetrate into the soil. This is particularly true on heavier, less permeable soils, which can store significant quantities of water for later use by the crop. Over the years, however, the cumulative effect of loss of top soil is more dangerous, and it occurs on the gentlest of slopes and over very short distances.

Analyses of profiles at Urambo in Western Tanganyika show that, in virgin sands and loams there, almost all of the plant nutrients and the small amount of organic matter are contained in the top four, and particularly the top two, inches. Surface wash, without necessarily doing any obvious physical damage, can readily remove this quantity of top soil in a very few years. In the Nachingwea area of Southern Tanganyika there are considerable areas of former native cultivation which now have truncated soils, from which the top layers have been washed off, leaving a hard, heavy impermeable subsoil exposed. Fortunately these soils are invaded by bamboo, under which a top soil is regenerated.

The loss of plant nutrients in crops and by leaching, and the increase of weeds, including parasites such as the witch weeds, are undoubtedly ancillary features of decline. In 1937 Milne[2] pointed out, in considering the failure of certain coffee plantations in the Usambara mountains, that fertility in these soils was not inherently high. The deceptively lush production of tropical forest vegetation arose from a rapid turnover of plant foods in a largely closed cycle. When the cycle was broken by clearing, the nutrients were lost and the cycle could not be made to support a plantation system of management. It is of the highest importance that the causes of fertility decline be quantitatively evaluated, and the processes by which the bush fallow restores fertility carefully analysed. Such knowledge will permit a more rational approach to the problems of modern farming development in the tropics, as well as of clearing. For example, the application of research into methods of soil management, and enlightened mechanical practice, can control surface wash. The work of Prentice[5] at Lubaga and Ukiriguru in Western Tanganyika, and more recently at Namulonge in Uganda, on tie ridging is especially important, and the broad lands described later have been useful. Field experiments can be used to determine the limiting nutrients, and indicate methods of weed control and conservative rotations, and so help to stabilize the system of farming. Much of the success of modern farming in South Africa, the Rhodesias, the Congo, French Equatorial Africa and East Africa has in fact been based on the application of such results to farming in wooded areas which primitive agriculture had been unable adequately to develop. It is obviously desirable to determine, and to be able to manage, the controlling factors before development begins.

Although the individual clearings may be small, the total area of wooded country which has in the past been affected by clearing must be very large. Much of the Congo evergreen forest is secondary, and the air traveller can see for himself the extent of relatively recent clearing that carries the characteristic Congo umbrella tree, *Musanga smithii*. In the same way the deciduous *miombo*, *msasa*, and similar *Brachystegia–Isoberlinia* communities in East, Central and West Africa, in the Congo and in the Sudan, which, with their associated vegetation

types, must cover a total of a million square miles, are for the most part, if not entirely, not climax communities, but subclimaxes limited by fire. Their natural climax is possibly a fire-sensitive evergreen thicket or forest. This state is believed to be associated over large areas with past clearing.

Land clearing for mechanized farming

There are three principal differences between clearing for primitive African farming and for modern farming. The modern farmer cannot face the continual capital cost of clearing in a bush fallow rotation; he requires freedom from obstructions by roots and stumps in the upper parts of the soil; and he needs much larger continuous acreages to deploy his equipment, thus creating new erosion risks.

It is therefore necessary to develop methods to deal with roots. This has probably been the largest single technical problem in clearing in the groundnuts scheme and by its nature it contains serious dangers of damage to the soil. Also, since the farming system is required to be permanent, other means than the bush fallow for maintaining fertility and conserving the soil must ideally be available from the outset.

The object of land clearing is taken to be the selection of areas of bush or forest-bearing land and their conversion into a condition suitable for mechanized farming. The stages in this process are: (i) survey, planning and selection of land to be cleared; (ii) felling of aerial parts of the wild vegetation; (iii) disposal of the debris from this operation; (iv) removal of stumps and roots; (v) disposal of debris from stumping and rooting; (vi) construction of a soil-conservation system.

An earlier review of these matters, with some details of equipment used, has been given by McBride *et al.*[6] Some of the figures given in that paper are slightly revised in the present account, as shown in Table II (p. 129).

Selection and planning of land

This section and that on soil-conservation methods are based largely on the experience gained in 1949–51 in the Southern Province of Tanganyika.[7c] This is the most striking instance known personally to the authors of primary land-use planning in new country, based on a broad ecological approach and carried into execution on a considerable scale.

The initial selection of areas to be examined for development is determined by broad considerations of soils, climatic régime, actual or potential water supplies and communications, existing land use and farming practice, human, political and economic problems, and the results of pilot research. The many problems involved cannot be considered here, save to point out that the land use and farming system of an undeveloped area are related to what may be achieved by more advanced methods only so far as both make use of the same sets of natural factors; some of these cannot, but others possibly can, be modified economically by more advanced technique, and so the possibility may exist of transforming the existing pattern of utilization by appropriate research and correct methods of development.

The first stage in the detailed examination of an area is the provision and survey of access roads and traces and of aerial survey marks for the control of aerial photography, which must be regarded as essential for any large-scale agricultural development, since it is by far the cheapest and most rapid way of securing a large amount of essential information. A scale of 1 : 12,000 to 1 : 25,000 on contact prints, according to the nature of the country, is required. The photographs must be flown at a time of year when there is a minimum of interference by fires or by cloud. In East Africa this tends to confine the work to the early part of the dry season. The prints should overlap 60% within the strips and 40% between them, for easy stereoscopic work. An accurate flight plan is essential.

A general reconnaissance survey of the whole area, along suitably spaced temporary traces and access roads, using the photographs, is next conducted to produce understanding of the topography of the area and an inventory of the main soil and vegetation types. Between

1000 and 1200 square miles were thus surveyed in 1949–50 in Southern Tanganyika by a team of about eight Europeans and their African helpers. A sample area is next surveyed and mapped in detail, by using the photographs, to determine the appearance on them of the main soil and vegetation types, to check the ecological classification and to establish the methods of work. Once this has been done further progress is relatively rapid, the mapping proceeding direct from the photographs, with frequent ground checks. From this, in Southern Tanganyika, a topographic, soil and vegetation map emerged, on a scale of 1 : 10,000 with contours at 10-ft. vertical intervals derived from instrument levelling.[7c]

At this stage the engineering structure of the development can be delineated, e.g. the communications and water-supply systems, the location of installations such as farm buildings, temporary and permanent camps, villages and service centres. Land unsuitable because of soil type, topography, dangerous slopes and difficulties of access and support, or for political and social reasons, can be delimited. The broad lines of the soil-conservation system are determined at this stage and, since they too depend on topographic considerations, the result is an integrated communications, services and conservation plan, the pattern of a workable countryside, in which the roads run along the ridges and spurs and the contoured land falls away to the hollows where the surplus water is discharged.

The areas to be cleared can now be marked on maps and on the ground, by using hand- or machine-cut traces. In 1951, 60,000 acres of land were accurately surveyed and mapped for clearing and conservation in Southern Tanganyika by these means, by the team already mentioned. By the end of 1952, 20,000 acres had been prepared for agriculture.

Felling of aerial parts of the vegetation

Economically useful timber should be extracted from the woodland before main felling starts; it becomes very much more difficult afterwards. At Kongwa very little timber of use except for firewood occurred in the natural vegetation, but in Western and Southern Tanganyika locally cut logs supplied a very large part of the engineering and domestic needs for sawn timber.

Numerous methods are available for removing the aerial parts of the vegetation. It is not often possible, in practice, to burn standing bush, since where there is sufficient grass to carry the fire, as in the *miombo* country of East and Central Africa, the majority of the trees resist fire; and, where the bush is sensitive to fire, either there is no grass to carry it through the bush (as in the Kongwa scrubs) or the dry season is not long enough to desiccate the vegetation. There are, however, intermediate situations, as at the margin of montane grasslands and evergreen forest or thicket, where grass fires in successive years can seriously damage the woodland and ultimately eliminate it.

Hand-felling in *miombo* vegetation was carried out experimentally in Southern Tanganyika; on the large scale it requires good organization, and can be followed, as in native practice, by burning. The cost per acre, for felling alone, is likely to be about 100 East African shillings (E.A.*s.* 100). Hand-felling is likely to be most successful in extending gradually the area of an established farm, by using the existing supervision and labour force in slack periods.

The killing of standing trees by 'ringbarking' or poisoning has not been tried on a large scale, but were it possible to obtain a kill by spraying from the air and to use fire for destruction of the dead vegetation later, useful economies in clearing costs should be effected.

Hand-winching when the subsoil is fairly moist has been carried out experimentally in Southern Tanganyika *miombo* at a cost of about E.A.*s.* 55 per acre. The result of later work with light tractor winches has not yet been published.

In the earliest days of the groundnuts scheme the dense 15-ft. *mchaka* or *Commiphora* scrub of Central Tanganyika was pushed over with bulldozers. When this was done in the dry season many of the trees snapped off, adding to the cost of stumping. In bulldozing, the whole area has to be traversed by heavy tractors, which tend to damage the top soil at any time of year as a result of track-slip. In 40–60-ft. open *miombo* woodland in Western Tanganyika this method of felling was abandoned in 1949 in favour of chain felling, which

was applied in the same year at Kongwa also. The two types of vegetation have been described elsewhere.[6, 7a, 8]

In chain clearing the ends of a section of anchor chain (9 in. × 1¼ in.) are attached to two heavy crawler tractors which move on parallel paths through the bush, where possible working round and round the area to be cleared. Their distance apart, which ranged from 20 to 50 ft., and the length of the chain (120–150 ft.), depend on the type of vegetation. The chain trails behind the tractors, weighted at its mid-point by a length of crawler track or a heavy steel-plate ball to control its tendency to ride up the trees. The chain flattens most of the vegetation in the strip between the tractors, by means of stem leverage, and when the soil and subsoil are moist the roots and stumps break off well below ground. A third tractor, fitted as a tree dozer, travels behind to help with tougher or inconveniently shaped trees. (A tree dozer has a blade carried on rising, hydraulically controlled arms, so that forward pressure can be applied 10–12 ft. above ground level.) If a really difficult tree is encountered it is by-passed by uncoupling the chain.

In this method only part of the soil surface is affected by the heavy equipment, and the felled vegetation is left lying in swathes parallel to the direction of movement. The work is far less damaging to the equipment than bulldozing the trees, which puts strain on tractor clutches, chassis and suspension and on the A frames of the bulldozers, for which they are not designed. The method represented a great saving as compared with bulldozing. In 1948 at Urambo felling took 1·28 tractor hours per acre; in 1950, with the chain, the figure was 0·74 and in 1951 0·71. At Kongwa, where 40,000 acres were cleared in 1949, the rate of felling by chain was 0·50 tractor hours, costing E.A.*s.* 33·73 per acre. (The cost of one tractor hour is taken as E.A.*s.* 67·45, a figure derived from the total costings of the work in 1949 at Kongwa. It is the only reliable tractor cost figure available to the authors and has been used in this paper to apply to all work done by heavy tractors in the groundnuts scheme. Whatever the disadvantages of this procedure, it does introduce an element of uniformity into comparisons of cost. The general question of costings in this work is discussed below.) The corresponding figure for Urambo chain felling, in the heavier *miombo*, would be E.A.*s.* 49·91 per acre.

In the Southern Province development, where clearing benefited by the earlier experience in the central and western areas, the chain-felling method was used almost exclusively. It appears to be the most useful method provided that the scale of operation is sufficient to carry the necessary maintenance and repair services. It is also by far the cheapest. Although chain felling is the most spectacular part of the clearing operation, it accounts for only 10–20% of the cost of clearing. The main problems are those of disposing of clearing debris and freeing the ground of roots and stumps.

Disposal of clearing debris

Clearing debris can only be burnt; the problem is how to do it. Destructive distillation was suggested in the early days of the groundnuts scheme, but rejected because either mobile plant or heavy transport costs would have been involved. Charcoal burning provides an economic outlet where the timber is suitable and transport and markets are available, but the clearance tends to be inefficient. In the earliest days of the groundnuts scheme bulldozers were used to push the debris, together with a not insignificant part of the top soil, into contoured piles which were subsequently burnt. This meant that the whole area had again to be traversed. At Kongwa in 1949, after chain felling, and without preliminary burning, piling took 1·75 hours per acre (compared with 0·5 for the felling) and cost E.A.*s.* 118 per acre. In 1950, in Urambo *miombo*, the piling, which consisted in pushing three swathes of debris into one, with rather less movement than at Kongwa, took 1·87 hours per acre and cost about E.A.*s.* 125 per acre. The mechanical piling of debris can be done effectively only when the surface of the soil is dry.

In 1948 it was found at Kongwa that a partial burning of debris without piling, though it was a troublesome and labour-consuming operation, reduced the time required for mechanical piling from about 2·0 to 1·3 hours per acre, simply by reducing the bulk of material. It was

necessary to wait about three months after the rains before the debris was sufficiently dry to be fired in this way, and so in practice the method was not much used.

In the wetter Southern and Western province areas, where grass growth after felling may be vigorous, efforts were made to clear the *miombo* debris, without piling it, by one or two dry-season burns. It appears that if the debris is left through more than one rainy season there is some danger of regeneration, but, where grass growth is adequate and weather conditions are well chosen, some success has been achieved in this way in Southern Tanganyika. Obviously such a method would have very great advantages.

There is room for closer studies of the rates at which termites and micro-organisms deal with woody residues in various soils and types of vegetation. Such an inquiry would naturally relate to chemical and microbiological studies, which are very much needed, of the part played by termites in the carbon and nitrogen cycles of tropical soils.

Most of the 20,000 acres of *miombo* which were developed for agriculture in the Southern Province of Tanganyika in 1950–52 were cleared of debris by hand piling and burning, which in 1952 cost E.A.*s.* 120 per acre (recomputed figure), including removal of stumps. The cost of doing this mechanically in Western Tanganyika in somewhat comparable vegetation was about E.A.*s.* 162·00, the price of 2·40 tractor hours per acre.

'Stumping' and root cutting

The removal of stumps is not necessary in peasant farming, but is essential to reduce damage to implements in mechanized farming. When chain felling has been done in moist soil the numbers of stumps remaining is heavily reduced. At Kongwa, where much bulldozing was originally done in the dry season, up to 100 stumps per acre might be left behind, and the stumping was done mechanically with Fleco stumpers and angledozers. (A stumper has a short steel blade with heavy teeth on its lower edge. It is mounted in place of the bulldozer blade, and can transmit pressure on a narrow front, downwards and forwards, so pressing out the stump. An angledozer blade is somewhat similar to the normal bulldozer blade, but is so shaped and controlled that the pressure of the tractor can be applied through one corner, acting downwards and forwards.) The cost was high and the damage to the soil resulting from the excavations and concentrated tractor movement was considerable. Even after chain felling in the rains, in 1949 at Kongwa, stumping took 0·75 tractor hour and cost about E.A.*s* 50 per acre. At Urambo in 1948, 1·92 tractor hours, costing E.A.*s.* 130 per acre, were required, but as the standard of felling improved these figures fell, and in 1950 the operation took 0·53 hour only, costing about E.A.*s.* 35. In the more recent work in Southern Tanganyika the stumping has been included with the clearing of debris as a hand operation.

The root pattern of the Kongwa scrub is as dense and tangled as the aerial parts. The removal of roots was a severe problem and one that was not satisfactorily solved. Work on it followed two lines: The first equipment tried was a simple three-tined le Tourneau ripper, which could rip the soil 18 in. deep but soon became festooned and choked with roots. Subsequently various modifications were produced, including a horizontal cutting plate welded to the front faces of the tines, individual plates of various shapes attached to the tines, and reduction of the number of tines to two. All these modifications were unsatisfactory, since, even though they might cut vertical roots, they did not cut horizontally placed roots, which they tore out by sheer force, rapidly becoming choked in the process. A new departure was the development of an experimental machine incorporating two very heavy discs as coulters for two triangular horizontal cutting blades, so combining a horizontal with a vertical cut. This machine worked well in trials, but was introduced into practice in a modified version, without the discs. In this form it had no special advantages. Efforts were also made to develop a constant-draught horizontal cutting blade, pivoted in the plane of its front edge, so that it maintained a horizontal position in the soil. The machine also had vertical cutting plates, and is reported to have done well in trials, but no further use was made of it.

The second line of attack was the use of heavy disc-ploughs, of which two types, the American Davis plough and the Ransome Shugadisc, both did quite well. On the whole this heavy ploughing has been more useful than the developed forms of ripping, but like them

it has the disadvantage, particularly in the wetter areas, that much subsoil is brought to the surface.

Root cutting is far easier in moist soils than in dry. In the earlier years great acreages were root-cut in dry weather, when many of the soils were compacted and all offered maximum resistance to the equipment. This led to heavy abrasion and greatly increased costs, but when the work was done at the correct time of the year the problem reduced itself to normal proportions.

Root cutting at 0·90 hour per acre cost about E.A.*s.* 61 per acre in 1949 at Kongwa. At Urambo it took, in different years, 0·89–1·49 hours per acre, costing E.A.*s.* 60–100 approximately per acre. To reduce these costs, and the damage to the soil associated with the work, trials were made both at Urambo and in the Southern Province in 1951 and 1952 of the use of farm tractors and ploughs for root removal. At Urambo the cost of this work, including the subsequent removal of roots and sticks by hand, is reported at about E.A.*s.* 71 on an area of over 1000 acres, including transport and overheads; this is probably a low value, as the figures used for the costs for the tractor, and particularly for the implement, are too low, as indeed is shown in a later report from the same area. When these later figures are used the cost per acre rises to almost E.A.*s.* 77 per acre, of which nearly 38 represent the machinery costs. No comparative assessment of the results of light and heavy ploughing has been given. Light ploughing might, however, be less damaging to the soil, but it seems to be necessary to repeat it several times, judging by the calculated time of operation (4·30 hours per acre).

Removal of root and stump debris

This stage of clearing was conducted mechanically with large rakes drawn by heavy tractors. The penetration was a few inches only, sufficient to remove the stumps and most of the superficial lengths of root lying on the surface. This took 0·40 and 0·60 hour per acre at Kongwa and Urambo in 1949 and 1950 respectively, at costs of E.A.*s.* 27 and 40. This is an operation best done mechanically in the dry season.

The results were seldom sufficiently complete for farming purposes, and the tendency has been for more and more of the work of twig-picking, as it came to be called, to be done by hand. In the Southern Province in 1952 this cost E.A.*s.* 18 per acre over 2000 acres.

Combination of mechanical and hand work in clearing

In the last three years much mechanical work, except felling and root cutting, has been replaced by hand work. In the Southern Province in 1952 the sequence was: mechanical felling; hand piling, stumping and burning; root cutting by heavy plough or normal farm plough; twig-picking by hand. It is possible, by collecting data from different areas, to estimate comparative costs. The standard figure of E.A.*s.* 67·45 per tractor hour, derived from a highly efficient, fully mechanized, large-scale operation at Kongwa in 1949, has to be used for all areas. Urambo machine costs have to be combined with hand-clearing figures from the Southern Province in some cases, since there are no published data on times of machine clearing from the South. The published costs of hand work in the South in 1952–53 in piling, stumping and burning are internally inconsistent and have been recomputed, giving the cost of this work at E.A.*s.* 138 per acre instead of E.A.*s.* 130. The results appear in Table I. A summary of all available information from Tanganyika on times of operation, with costs computed by using the standard tractor hour, is given in Table II. Table III gives the costs structure for the standard tractor hour, based very largely on old Caterpillar D8 tractors, operated under hard conditions.

Costings

The question of what is a true cost in work of this kind is usually a somewhat philosophical one. The efficiency of supervision and management affects the definition of overheads, and there is always doubt about capital depreciation rates and the charging of spares and major

Table I

Estimated costs of land clearing by various methods in various areas of Tanganyika, 1949–52 (chain felling in all cases)

	Tractor hours/ acre	Cost/acre, E.A.s.
I. Fully mechanized clearing of *Commiphora* scrub, Kongwa, 1949		
Felling	0·50	33·73
Piling	1·75*	118·00
Stumping	0·75*	50·59
Root cutting	0·90*	60·70
Raking	0·40*	26·98
Total (final hand picking, levelling and cost of burning not included)	4·30	290·00
II. Fully mechanical clearing of *Brachystegia–Isoberlinia* woodland, Urambo, 1950		
Felling	0·74	49·91
Piling	1·87	126·13
Stumping	0·53	35·75
Root cutting	1·41	95·10
Raking	0·61	41·14
Total (final hand picking, levelling and cost of burning not included)	5·16	348·03
III. Mechanical felling and piling followed by light ploughing and hand removal of stumps, root and other debris, Urambo, 1950–51		
Felling	0·74	46·91
Piling	1·87	126·13
Ploughing (light tractor) (recomputed)	4·30	37·53
Other costs including supervision and overheads		39·52
Total		253·09
IV. Mechanical felling, hand piling, stumping and burning, heavy ploughing, hand clearing of debris, Urambo, 1950, and Southern Province, 1952		
Felling	0·74	49·91
Ploughing (heavy)	1·41	95·10
All hand operations		138·11
Total		283·12
Approximate total if light ploughing is used		230

* Revision of figure given by McBride *et al.*[6]

overhauls, until experience extends over a number of years. Of the standard tractor-hour charge, 46% consists of depreciation and spares for plant and transport. No element for the overheads of the groundnut-scheme management is included in this charge, which is at contractors' level. These overheads will, however, have some influence on the hand-labour costs, though not a large one.

No figure is available for the costs of survey, land-use planning and soil conservation. Further, the figures given can refer only to the vegetation types from which they are derived, or to similar types, and they do not include other elements of capital cost, such as permanent water supplies, communications, buildings (housing, farm and service installations), all of which are required when new country is opened up on a large scale.

The figures given permit a number of useful inferences. The lighter character of the Kongwa bush is reflected in the lower cost (E.A.s. 290 per acre) of mechanical clearance there than in the heavier woodland of Urambo (E.A.s. 350 per acre). These figures do not include the costs of levelling (where necessary), burning and hand picking of small debris. The restriction of heavy machine work to felling and ploughing, with all other work done by hand, reduced the cost for clearance of *miombo* from over E.A.s. 350 per acre to E.A.s. 280 per acre. The further substitution of light for heavy ploughing reduces the cost to about E.A.s. 230 per acre. It seems unlikely that this figure could be brought below E.A.s. 200 per acre. In addition to the reduction in cost, an increase in the hand-labour content of the clearing operation reduces damage to the soil.

Chain felling and heavy ploughing are the only heavy-tractor operations in clearing that have justified themselves in Tanganyika, and heavy ploughing may be replaced with economy, though probably with some loss in root-cutting efficiency, by light-tractor ploughing. The

Table II

Times of operation and costs for various land-clearing operations, Tanganyika, 1947–52; standard heavy-tractor-hour cost, E.A.s. 67·45

Operation	Time/acre, h.	Cost/acre, E.A.*s.*	Source†
I. Felling			
Bulldozer, Urambo, 1948	1·28	86·34	6
Chain, Kongwa, 1948–49	0·50	33·73	6, 7*a* (81)
,, Urambo, 1949	0·94	63·40	6
,, ,, 1950	0·74	49·91	6
,, ,, 1951	0·71	47·89	7*d* (132)
Hand felling, Southern Province, 1952 (estimated)		110	7*e* (303)
Winching, Southern Province, 1952 (approx.)		55	7*e* (303)
II. Piling			
Kongwa, 1948	2·00	139·90	7*a* (81)
,, ,, after burning (approx.)	1·30	87·68	7*b* (68)
,, 1949	1·75*	118·00	Contractors costs, 1949
Urambo, 1948	2·70	182·12	6
,, 1949	1·52	102·52	6
,, 1950	1·87	126·13	6
Hand piling and burning		119·76	7*e* (306) recomputed
III. Stumping			
Kongwa, 1948	0·70	47·22	7*a* (81)
,, 1949	0·75*	50·59	Contractors costs, 1949
Urambo, 1948	1·92	129·50	6
,, 1949	1·55	104·55	6
,, 1950	0·53	33·75	6
IV. Root cutting			
Heavy tractors, Kongwa, 1948	1·00	67·45	7*a* (81)
,, ,, ,, 1949	0·90*	60·70	Contractors costs, 1949
,, ,, Urambo, 1948	1·49	100·50	6
,, ,, ,, 1949	0·89	60·03	6
,, ,, ,, 1950	1·41	95·10	6
Light tractors, Urambo, 1951	4·30	37·53	7*d* (139), revised with 7*e* (100)
V. Raking			
Kongwa, 1948	0·50	33·73	7*a* (81)
,, 1949	0·40*	26·98	Contractors costs, 1949
Urambo, 1948	1·59	107·25	6
,, 1949	0·64	43·17	6
,, 1950	0·61	41·14	6
VI. Miscellaneous			
Hand piling, stumping and burning, Southern Province, 1952		119·76	7*e* (306) recomputed
Twig-picking, Southern Province, 1952		18·35	7*e* (306)
Ripping, Kongwa, 1948	0·60	40·47	7*a* (81)

* Revision of figure given by McBride *et al.*[6]
† Figures in brackets after references 7*a–e* refer to paragraphs of the reports.

restriction of the use of heavy equipment to felling and root cutting, which can be efficiently done only when the soil is moist, in the wet season, will increase costs unless the overheads can be spread over other work during the remainder of the year, since otherwise the idle time has to be paid for. The original estimate of clearing cost, made in 1946, was £3 17*s.* 4*d.* (sterling) per acre.[9]

The main prospects for future improvement seem to be in the more efficient use of time, fire and decay for disposal of clearing debris, and in handing over as much as possible of the work to farm staffs, thus reducing overheads. This would have the effect of spreading the

clearing, after the initial chain felling, over several seasons, and indeed the longer clearing takes by this means the better, so long as the annual firing controls regeneration. In this connexion chemical or herbicidal control might prove especially valuable.

Special attention has been directed to the high incidence, 62·9 per thousand, of tropical ulcers in the labourers employed in clearing. Each cost an average of E.A.s. 280 to cure. The ulcers arose from infection of minor cuts and abrasions, and have been heavily reduced, to about 12% of their former incidence, by daily inspection, disinfection and sealing of damaged tissues.

Soil conservation

Once the natural cover has been removed, the land must be protected against erosion before the next rains commence. In the groundnuts scheme no land with a slope (sine) greater than 5% was developed. For the purpose of conservation planning each cleared block or field in Southern Tanganyika was surveyed before root cutting took place, on a scale of 1 : 5000, with contours at 2-ft. vertical intervals. On this survey the field water disposal areas were located, and ploughing lines were pegged on the contour in the field to guide the operators. Next, narrow-based terraces or diversion banks were put in, on variable grade, discharging either into unfelled bush or into the water-disposal areas, which were bounded

Table III

Cost structure (E.A.s.) for heavy tractor used in land clearing; Kongwa, Tanganyika, 1949 (40,000 acres)

Component of cost	Cost per acre cleared	Cost per tractor hour
Depreciation and spares		
Tractors	105·0	
Ancillary equipment	11·0	
Motor transport	17·5	
Total	133·5	31·05
Petrol, oil and lubricants		
Tractors	38·0	
Motor transport	9·5	
Camp	1·0	
Total	48·5	11·05
Miscellaneous items		
Workshops, offices, stores	1·7	
Workshop machinery (depreciation and spares)	2·0	
Water	1·7	
Small equipment and tools	1·9	
Consumables (oxygen, acetylene, ropes etc.)	2·7	
Total	10·0	2·56
European salaries		
Direct	31·5	
Headquarters	4·5	
Allowances, passages, housing, furniture	34·0	
Total	70·0	16·28
African wages, including housing and food	28·0	6·51
Total	290·0	67·45

by training banks to retain the water. Finally the inter-terrace areas (which came to be known as panels) were surveyed and the field was handed over to the farmer, with a detailed plan. At Kongwa contour lines were marked in the felling debris by using a level on a bulldozer; the debris was then pushed on to these lines to form a protective bank.

So far the soil-conservation plan broadly follows standard practice, based mainly on the system of the United States Soil Conservation Service, modified by South African and

Rhodesian experience. It was found, however, that although this prescription prevented major damage, it could not prevent surface wash between the terraces. Grass strips were also inefficient for this purpose. The so-called broad-land system of ploughing developed at Urambo in 1949, in which broad ridges, 12 ft. wide, are constructed on the contour by two runs of a 6-ft. one-way disc plough, largely controls surface wash and prevents local ponding. This system resembles the old-fashioned cops and reans, stitches, or lazy beds of British farming, or the ploughed lands of Northern Italy, except that it prevents run-off instead of facilitating it. It is evident from more recent reports of the Overseas Food Corporation that this system has gradually commended itself to the farmers and is becoming more widely used.

The broad lands, by greatly reducing the volume of discharge from the land, especially where row-crop ridging is also practised, reduce the burden of protection falling on the terrace system. In some areas the terraces are being experimentally converted into broad-based terraces, maintained by the plough, over which crops are grown.

The organization of clearing

The organization of clearing is both complex and important. The operations must be conducted at the proper seasons—felling and root cutting when soil and subsoil are suitably moist, clearance of debris and burning under dry conditions. Thus the ideal sequence, to whatever extent it is mechanized, must occupy at least two wet seasons, and efforts to accelerate it will be harmful and expensive.

The methods to be used in any situation should be carefully investigated in the pilot phase of the development,[10] together with agricultural, land-use and conservation research. In particular, comparative trials of different types of heavy equipment must be complete before any major effort is started. To test new types of equipment once a clearing programme has been started is wasteful, since even should a change to new equipment be indicated it will almost certainly prove economically impossible to implement it. It is of the highest importance to use only a single type of tractor in any one development, since this minimizes the requirements for spares, accessories, special tools, types of lubricant and specially trained staff.

The supporting services for the equipment—field maintenance, workshops, supplies, spare parts—should be in existence before a single machine goes into the field. Training of staff should develop logically from the pilot phase. Where hand labour is to be used, means of recruiting, managing and caring for the labour force have to be evolved first. All this seems elementary, but experience has shown how readily enthusiasm will neglect it.

It may be of interest to record some figures of staffing and performance derived from the complete mechanical clearance of 40,000 acres of *Commiphora* scrub at Kongwa in 1949. The most useful size of team seems to be one with about 75 heavy tractors. For such a team, working 2 shifts a day with 10 hours daily of actual operation per tractor, under Tanganyika conditions, 67 Europeans and 570 Africans, including all support other than medical services, would be required. Allowing for idle, broken-down and workshop time by supplying a team with 20 reserve tractors, giving a total of 95, it could clear 50,000 acres in a year, or roughly 500 acres per tractor. When engaged on chain felling, the 75 working tractors would deal with 1500 acres per 10-hour day, thus completing the felling for a year's clearing in under 5 weeks. In *miombo* such a team would fell nearly 1100 acres a day; thus in 120 working days it would cover 132,000 acres or over 200 square miles.

Summary: The present status of the land-clearing problem

The agricultural development of bush- or forest-covered land has often been approached as an engineering problem to be solved by the use of mechanical technique and heavy equipment. This outlook leads to high costs and to insensitiveness to geographical and agricultural factors. From initial selection to the sowing of the first crop, the topography, climate, soil, vegetation and future farming system are the determining factors. Methods of land selection, survey and land-use planning (including conservation planning) based on these

considerations are now available; in any new situation they will have to be applied to local circumstances and appropriate techniques devised for making best use of them.

The physical execution of land clearing is best regarded as an extended agricultural process aimed at the production of farming land. The long- and short-term effects of the clearing process on the soil are at least as important as its cost. So far it appears that the use of heavy equipment is mainly justified in the felling operation, where chain felling appears to be the most efficient method available. It has to be done when the soil is moist. Mechanical piling and stumping are costly and damaging to the soil. They may be avoided by carrying out the felling so that few stumps are left behind and by the organized use of natural decay and fire to destroy debris. The clearing of the debris is dry-weather work.

The removal of roots, which is an essential preliminary for mechanized farming, is of necessity a mechanical operation, to be carried out when the soil is moist. In suitable types of vegetation, particularly where woody regeneration is negligible, or can be controlled with herbicides, natural decay and normal ploughing may give a sufficiently rapid result. In other cases heavy mechanical rooting operations may be required, but so far no commercial implement, capable of removing roots efficiently without far-reaching effects on the soil, is known. The heavy disc plough may be suitable where deep inversion of the soil can be accepted.

Conservation techniques of general applicability are not yet available, since surface wash, which is serious in many tropical areas, even on slopes less than 0·1%, is not countered by standard practice and requires locally determined control measures suited to each area. Where standard works (broad-based terraces and the like) are required they are best built when the soil is moist. Thus a major clearing operation, in a new area, should be preceded by local investigations into land selection and land-use planning techniques, into clearing methods, especially rooting, and into soil-conservation practice. These points are at least as important as conventional agricultural research. The design of an effective root cutter deserves urgent attention.

In a semi-arid country complete clearing in a single season, though it may be technically possible, is inadvisable unless hand labour is used for much of the work. It is probable that the most suitable sequences will occupy two wet seasons, though some land may be cropped in the second year if rooting and the building of soil-conservation works are completed sufficiently early in the second season.

The principal future advances in clearing procedure seem likely to come from the use of herbicides and defoliants together with fire and decay.

Note added in proof: Two useful relevant papers have now become available. Bartholomew, Meyer & Laudelout[11] have studied the distribution and economy of dry matter and plant nutrients in the forest system of the Central Congo at Yangambi, and have indicated how clearing and burning affect them. Grantham & Pilson[12] have published an account of the forward reconnaissance and survey methods used in Southern Tanganyika by the Overseas Food Corporation.

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STUDIES OF LACTIC ACID BACTERIA ASSOCIATED WITH BREWERY PRODUCTS. III.*—Amino-acid Requirements of 34 Organisms

By R. R. BHANDARI, C. RUSSELL† and T. K. WALKER

The amino-acid requirements of 34 strains of lactic acid bacteria have been investigated. All the organisms required glutamic acid and leucine, but none required histidine, hydroxyproline, methionine, norleucine or norvaline. The maximum number of amino-acids essential to any organism was ten, and the minimum was two. In some cases the omission, as a group, of individually non-essential amino-acids resulted in failure of growth.

Orla-Jensen, Otte & Snog-Kjaer[1] were the first to determine some of the amino-acids required by a number of lactic acid bacteria. Since then numerous strains have been investigated, particularly in connexion with the microbiological assay of amino-acids. A most systematic study was that by Dunn *et al.*[2] with 23 organisms. However, the beer lactic acid bacteria have hitherto been neglected. All the strains studied in the present investigation were isolated from beer or from brewing yeast by Bhandari, Russell & Walker.[3]

Experimental

The organisms, the basal medium used for their cultivation, and the techniques employed were the same as those described in a previous communication (Part II of the present series) by Russell, Bhandari & Walker.[4]

The amino-acid requirements of the organisms are set out in Table I; the amino-acids are arranged in order of indispensability and the organisms in order of fastidiousness. The criteria adopted are as in the earlier paper.

The amino-acids most commonly required were glutamic acid (34), leucine (34), tryptophan (28), valine (25) and threonine (23), the number of organisms for which each of these acids is essential being shown in parentheses. On the other hand, none of the 34 organisms required histidine, hydroxyproline, methionine, norleucine or norvaline. Five organisms, including two strains of *Lactobacillus bifidus* and two of *Lb. pastorianus*, required ten amino-acids for normal growth, and the minimum number of any amino-acids essential to any organism was two (*Lb. pastorianus*, strains 19 and W5).

Although the criterion for essentiality was taken to be a decrease in bacterial turbidity to one-quarter of the control, in most cases the decrease was much larger, to one-tenth or less of control turbidity. However, for a number of organisms the omission of certain amino-acids resulted in an increase in turbidity. The amino-acids most commonly involved were cystei , hydroxyproline, norvaline and *iso*leucine.

attempt was made to grow a number of organisms on 'minimal media', i.e. media containing only their essential amino-acids in addition to the other constituents of the complete medium. In these circumstances the majority of bacteria failed to grow well; in fact only one organism, *Lb. pastorianus* L, grew equally well in the minimal medium as in the complete medium. It was thus evident that the essential amino-acids shown in Table I did not represent the optimal requirements, except for *Lb. pastorianus* L.

The 'minimal media' were then modified by the addition of further amino-acids, singly and as a group, and comprised those thought most likely to improve growth. In two cases only, namely *Lb. buchneri* C with arginine and *Lb. plantarum* ϕ with tyrosine, did the addition of a single amino-acid raise growth to at least half the normal growth. Even when all the supplemental amino-acids were added most organisms did not grow; however, *Lb. pastorianus* HH4 now reached the level of growth in the complete medium. A later experiment indicated

* Part I: *J. Sci. Fd Agric.*, 1954, **5**, 27; Part II: *J. gen. Microbiol.*, 1954, **10**, 371

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that cysteine, tyrosine, arginine and proline, which were individually more effective than any other amino-acid, represented the minimal requirements of *Lb. pastorianus* HH4 in addition to those determined earlier.

Discussion

There is great variety in amino-acid requirements among different strains of any particular species. Thus the strains of *Lb. pastorianus* vary as follows (number of requirements in parentheses): W4, BB4 (10); DD4, W1 (9); 12, 23, L (8); BB1, W10, D (7); CC4 (5); HH4 (4); 19, W5 (2).

The four strains of *Lb. leichmannii* are very similar bacteriologically and all require glutamic acid, leucine, valine, asparagine and glycine. However, in addition they have the following requirements: AA1, cysteine, phenylalanine, tryptophan; AA2, cysteine, arginine, threonine; AA3, lysine, proline, serine, phenylalanine; AA4, tryptophan, phenylalanine. Schweigert, Guthneck & Scheid[5] found that their strain of *Lb. leichmannii* did not require glycine, leucine, lysine, proline, serine, threonine or tyrosine, a marked contrast to the strains examined in the present work. Similarly the strain of *Lb. buchneri* employed by Dunn *et al.*[2] required seven amino-acids, three of which were not required by any of the six strains of this species studied in the investigations now reported.

Inhibition of bacterial growth by amino-acids has been known for some time. Thus *iso*leucine has been found to be inhibitory to *Lb. arabinosus*,[6] and data presented by Dunn *et al.*[2] show that norvaline inhibited *Lb. gayonii* 8289 and *Lb. citrovorum* 8081 appreciably.

Table I

Amino-acid requirements of 34 strains of lactic acid bacteria

	Glutamic acid	Leucine	Trypto-phan	Valine	Threo-nine	Arginine	Glycine	Serine
Lb. bifidus DD5	E	E	E	E	E	E	E	E
Lb. bifidus EE1	E	E	E	E	E	E	E	E
Lb. pastorianus BB4	E	E	E	E	E	S	E	E
Lb. pastorianus W4	E	E	E	E	E	E	E	S
Pediococcus damnosus var. *salicinaceus* FF6	E	E	E	E	E	E	E	E
Lb. buchneri α	E	E	E	E	E	E	E	E
Lb. buchneri β	E	E	E	E	E	E	E	E
Lb. frigidus HH5	E	E	E	S	E	E	E	E
Lb. leichmannii AA3	E	E	S	E	N	S	E	E
Lb. pastorianus DD4	E	E	E	E	E	E	S	E
Lb. pastorianus W1	E	E	E	E	E	E	E	S
Lb. bifidus DD1	E	E	E	E	E	S	E	E
Lb. buchneri K	E	E	E	E	E	E	S	E
Lb. leichmannii AA1	E	E	E	E	N	S	E	N
Lb. leichmannii AA2	E	E	S	E	E	E	E	N
Lb. malefermentans	E	E	E	E	E	E	N	S
Lb. pastorianus 12	E	E	E	S	E	S	E	E
Lb. pastorianus 23	E	E	E	N	E	E	S	N
Lb. pastorianus L	E	E	E	E	E	E	N	N
Strep. cremoris	E	E	E	E	E	E	N	E
Lb. leichmannii AA4	E	E	E	E	N	N	E	N
Lb. leichmannii EE4	E	E	E	N	N	E	N	N
Lb. pastorianus BB1	E	E	E	E	E	S	E	E
Lb. pastorianus W10	E	E	E	E	N	S	E	N
Lb. pastorianus D	E	E	E	E	E	S	E	E
Lb. buchneri C	E	E	E	E	E	S	S	S
Lb. buchneri CC3	E	E	E	N	N	E	N	N
Lb. pastorianus CC4	E	E	E	E	N	N	N	N
Lb. buchneri 1	E	E	N	N	E	N	N	N
Lb. parvus	E	E	S	E	E	N	N	N
Lb. pastorianus HH4	E	E	E	S	N	S	N	N
Lb. plantarum φ	E	E	E	E	N	N	N	N
Lb. pastorianus 19	E	E	N	N	N	N	N	N
Lb. pastorianus W5	E	E	N	N	N	N	N	N

E = essential, S = stimulatory, N = non-essential. None of the remaining amino-acids used in the experiments was essential.

Table I (*continued*).

	Alanine	Proline	Asparagine	Lysine	Tyrosine	Phenylalanine	Cysteine	*iso*-Leucine
Lb. bifidus DD5	N	E	N	E	S	N	N	N
Lb. bifidus EE1	S	E	N	N	E	N	N	N
Lb. pastorianus BB4	E	E	E	N	S	N	N	N
Lb. pastorianus W4	E	N	E	E	S	N	N	N
Pediococcus damnosus var. *salicinaceus* FF6	N	E	N	N	E	N	N	N
Lb. buchneri α	N	S	S	E	S	N	N	N
Lb. buchneri β	N	S	N	E	S	N	N	N
Lb. frigidus HH5	S	E	N	S	E	N	N	N
Lb. leichmannii AA3	S	E	E	E	N	E	S	N
Lb. pastorianus DD4	N	E	S	E	S	N	N	N
Lb. pastorianus W1	N	N	E	N	N	N	N	E
Lb. bifidus DD1	S	E	N	N	S	N	N	N
Lb. buchneri K	N	N	E	N	S	N	N	N
Lb. leichmannii AA1	N	N	E	N	S	E	E	N
Lb. leichmannii AA2	N	S	E	S	S	S	E	N
Lb. malefermentans	E	N	N	E	N	N	N	N
Lb. pastorianus 12	E	E	N	N	S	N	N	N
Lb. pastorianus 23	E	E	E	N	S	N	N	N
Lb. pastorianus L	N	N	E	E	N	N	N	N
Strep. cremoris	E	S	N	N	E	N	N	N
Lb. leichmannii AA4	S	N	E	N	N	E	N	N
Lb. leichmannii EE4	E	S	N	N	E	E	N	N
Lb. pastorianus BB1	S	S	N	N	N	N	N	N
Lb. pastorianus W10	E	E	N	N	N	N	N	N
Lb. pastorianus D	N	S	S	N	S	N	N	N
Lb. buchneri C	N	S	E	S	N	N	N	N
Lb. buchneri CC3	E	N	N	N	E	S	N	N
Lb. pastorianus CC4	N	N	N	N	E	N	N	N
Lb. buchneri 1	E	N	N	N	N	N	N	N
Lb. parvus	N	N	N	S	N	N	N	N
Lb. pastorianus HH4	E	S	N	N	S	S	S	N
Lb. plantarum φ	N	N	N	N	S	N	N	N
Lb. pastorianus 19	S	N	N	N	N	N	N	N
Lb. pastorianus W5	S	N	N	N	N	N	N	N

E = essential, S = stimulatory, N = non-essential. None of the remaining amino-acids used in the experiments was essential.

The relationships between alanine, phenylalanine and tyrosine are interesting. Eight organisms required simply alanine, three simply phenylalanine, and seven simply tyrosine; one required alanine and phenylalanine, and three required alanine and tyrosine; one organism, *Lb. leichmannii* EE4, required all three of these amino-acids. So far as the authors are aware, no other lactic acid organism has been shown to require these three amino-acids simultaneously. Lyman *et al.*[7] stated that *Streptococcus faecalis* R required them, but Greenhut, Schweigert & Elvehjem[8] reported these amino-acids to be only stimulatory for this organism.

The fact that cysteine is required by only two organisms, *Lb. leichmannii* AA1 and AA2, is of interest in view of the findings of Speck & Pitt.[9] They grew *Lb. arabinosus*, *Lb. casei* and *Strep. faecalis* in the absence of cysteine, but in the presence of pyridoxamine and pyridoxal. The cells were found to contain cysteine. However, in the absence of the B_6 vitamins, the organisms required cysteine for growth. The amino-acid requirements now reported were found in the presence of the B_6 group. It has been established[10] that a number of the organisms which, in these conditions, do not require cysteine do not grow if both cysteine and vitamin B_6 are omitted (the B_6 group alone is not essential). These results will be reported in more detail at a later date.

A study of the nicotinic acid requirements of the organisms[4] and of the tryptophan requirements shown in Table I reveals that 20 organisms require both nicotinic acid and tryptophan, and that no organism is wholly unaffected by the omission of one or the other of these substances. That an intimate relationship between the metabolism of nicotinic acid and tryptophan exists is well known.[11]

It does not appear to be common practice to attempt to grow bacteria on media containing only their 'essential' amino-acids. However, Hegsted,[12] using *Lb. arabinosus* 17-5,

found that it would not grow in a medium containing the ten amino-acids determined to be essential. The further addition of the stimulatory amino-acids lysine, threonine and aspartic acid, as a group, facilitated normal growth. No matter what combination of amino-acids was used, growth failed if both threonine and aspartic acid were omitted. Thus, the failure of organisms to grow in media containing only 'essential' amino-acids may be a useful indication of metabolic inter-relationships between two or more of the omitted substances.

Acknowledgments

Thanks are due to the Manchester City Council for a Postgraduate Scholarship held by one of us (C. R.). One of us (R. R. B.) was a Scholar of the Rajasthan Government.

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Received 6 August, 1954

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STUDIES ON DRIED PEAS. I.—The Determination of Phytate Phosphorus

By R. HOLT

The relation of phytate concentration to colour produced by standard quantities of thiocyanate and ferric iron in a solution is inverse and almost linear. This is the basis of the method proposed for the determination of phytate phosphorus. It has been applied to the determination of quantities between 75 and 150 μg. in extracts from dried peas with an accuracy of ± 5%. Chloride, sulphate, citrate, tartrate and malate do not interfere in concentrations of the same order as that of the phytate. Interference by 0·1 mg. of orthophosphate phosphorus is negligible; 0·4 mg. causes a positive error of less than 5%. It is suggested that there may be less interference in aqueous alcohol.

It has been suggested by Mattson[1] that the cooking properties of dried peas are related to the quantity of phytate phosphorus which they contain. In order to explore this possibility more thoroughly, a method was needed for the determination of phytate phosphorus. It had to be applicable to dried peas and should require a minimum of working time, because a large number of determinations were to be made. It did not, however, need to be highly accurate, as relatively large differences in phytate-phosphorus content were in question. It was thought that an accuracy of ± 10% would probably have been satisfactory and ± 5% certainly so.

In the work referred to above Mattson used the method of Harris & Mosher[2] for his phytate-phosphorus determinations. Briefly this method is to precipitate ferric phytate from acid solution by adding an excess of standard iron solution, filter and determine the excess of iron in the filtrate colorimetrically by means of ammonium thiocyanate. The difference

between added and excess of iron is used to calculate the phytate phosphorus. McCance & Widdowson,[3] Common [4] and Pringle & Moran[5] have used various modifications of a method which is based on the determination of phosphorus in ferric phytate precipitated from acid solution.

The method now proposed makes use of a similar principle to that on which the method of Harris & Mosher depends, but by working at suitably low concentrations precipitation and filtration can be avoided. In solutions containing phytate, thiocyanate and ferric ions the two main reactions may be represented as follows:

$$Fe^{3+} + 3SCN^- \longrightarrow Fe(SCN)_3$$
$$Fe^{3+} + \text{phytate} \longrightarrow \text{Fe phytate}$$

(The exact representations of the numerous equilibria involved need not be considered here.) The reactions are interdependent and both are also affected by the acidity of the solution. The effect of the phytate ion on the iron–thiocyanate reaction will obviously be to reduce the intensity of the ultimate colour. In suitably chosen concentrations of the reactants and of acid this diminution of the colour intensity is almost proportional to the phytate concentration over a limited range. The phytate content of a solution can in such cases be obtained by reference to a calibration curve prepared with the same quantities of iron, thiocyanate and acid and a standard phytate preparation.

The ferric thiocyanate reaction is affected by many anions. Of those studied only oxalate was found to be comparable with phytate in its effect, but if the ratio of phytate to orthophosphate is low some interference from the latter may be expected.

Experimental

Standard phytate solution

As far as the author is aware, pure phytic acid or a pure phytate is not made commercially in this country. The standard used throughout this work was a crude preparation of ' phytin '—a mixed calcium and magnesium salt of phytic acid. It had the following analytical characteristics:

Total phosphorus	186 mg./g.
Inorganic phosphorus	20 mg./g.
Phytate phosphorus	155 mg./g.

(Determined by method of Pringle & Moran[5])

The phosphorus unaccounted for is possibly in the form of intermediate inositol phosphates. A 0·1% solution of this material in 0·5N-nitric acid was used as a standard solution. The phytate and inorganic phosphorus were checked periodically, and although there was evidence of a slight increase in the latter the former did not vary over a period of six weeks.

Conditions of reaction

Acidity, thiocyanate and iron concentrations all affect the sensitivity of the iron–thiocyanate reaction to the presence of phytate.

Acidity.—Although Harris & Mosher used hydrochloric acid, nitric acid is usually preferred as a medium for the ferric thiocyanate reaction,[6] and was therefore employed throughout this work. The following figures show that as the acid concentration is reduced the effect of the phytate ion on the ferric thiocyanate reaction increases.

Iron, mg./25 ml.	Ammonium thiocyanate, mg./25 ml.	Acidity	Reduction of colour intensity by 0·5 ml. of phytate solution, %
0·20	10	0·2N	49
0·20	10	0·1N	60

The advantage of this increase in sensitivity is more than offset by a roughly threefold increase in the effect of phosphate on the colour intensity for a similar change in acidity. Because of the possibility of phosphate interference it is desirable to choose the maximum

acid concentration which will give a sensitivity of the ferric thiocyanate colour to phytate appropriate to the quantities of phytate to be determined. For the author's purposes 0·2N has been found satisfactory.

Thiocyanate and iron concentrations.—The concentration of these may be varied as convenience and accuracy dictate. The possible variations have not been studied exhaustively so as to obtain the best possible conditions, but it was established that the sensitivity of the ferric thiocyanate reaction to phytate can be increased up to a certain point by decreasing the concentration of thiocyanate and increasing that of the iron. In Table I are figures which illustrate this. They also indicate how the conditions may be varied to cover the required range of phytate concentrations.

Table I

Effect of iron and thiocyanate concentrations on sensitivity of ferric thiocyanate colour to phytate

Iron, mg./25 ml.	Ammonium thiocyanate, mg./25 ml.	Optical density		
		No phytate	0·5 ml. of phytate solution	1·0 ml. of phytate solution
0·06	40	0·81		0·38
0·08	20	0·80		0·23
0·12	10	0·81		0·24
0·20	10	1·50	0·79	0·39

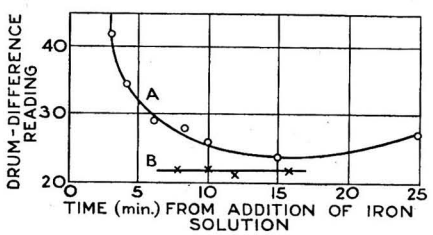

FIG. 1.—*Effect of heat on colour development*

Time of measurement

In the cold, equilibrium between iron, thiocyanate and phytate is not attained instantly. The interaction of iron with thiocyanate is virtually instantaneous, but that of iron with phytate is apparently not so. After the thiocyanate is added the absorption falls slowly to a minimum and then begins to increase. The slow reduction in the colour from its original intensity is apparently due to the time taken for iron and phytate to reach equilibrium. The subsequent increase in the absorption occurs when ferric phytate begins to be precipitated. The changes that take place are illustrated in Curve A of Fig. 1.

Effect of heat

Because the time taken for the minimum absorption to be reached varied somewhat an attempt was made to attain equilibrium more quickly by heating the iron and phytate together before addition of the thiocyanate. The tubes containing the first two reactants in a total volume of 24 ml. were immersed in a boiling-water bath for 30 and 60 seconds in two experiments respectively. After cooling to 20° and adding the thiocyanate the colours were stable from their first being measured (Curve B, Fig. 1). The colour intensity varied according to the duration of the heating. To apply the method directly to plant extracts a minimum period of heating seemed desirable and the shorter time was therefore used subsequently.

Temperature of measurement

This is important. There is a decrease of approximately 0·005 in optical density per degree rise in temperature. All measurements were made at 20 ± 1°.

Preparation of calibration curve

It is not suggested that the foregoing study of the variables is exhaustive. After consideration of such results as were obtained the following method was used for preparation of a calibration curve:

Solutions.—(1) Standard phytate solution: prepare as described above.

(2) Stock solution of iron: dissolve 1·0 g. of pure iron wire in 25 ml. of concentrated nitric acid and make up to one litre with distilled water.

(3) Dilute solution of iron: dilute one volume of the stock solution to twenty-five volumes with distilled water.

(4) 0·5N-nitric acid.

(5) 1% (w/v) ammonium thiocyanate solution.

Procedure.—Into a boiling-tube of about 100 ml. capacity pipette aliquots in 0·1-ml. increments of between 0·5 and 1·0 ml. of standard phytate solution. Add sufficient 0·5N-nitric acid to make the total volume 10 ml. Then add 9 ml. of distilled water and 5 ml. of dilute iron solution. Mix and stand the tube in a boiling-water bath for exactly 30 seconds. Cool immediately to 20 ± 1° and add 1 ml. of 1% ammonium thiocyanate solution. Mix and measure the colour intensity in an absorptiometer. With a 'Spekker' instrument, Ilford Blue (602) filters and a 4-cm. cell were used. Plot the drum reading against ml. of standard phytate solution. To convert the latter value into mg. of phytate phosphorus multiply by 0·155.

Range

With quantities of standard phytate solution greater than 1·0 ml. precipitation of ferric phytate is liable to occur. There is no reason to believe that the method would not work with quantities less than 0·5 ml. of standard phytate solution.

Interference

(*a*) *Phosphate.*—The effects of 0·4 and 2·0 mg. of orthophosphate phosphorus in the presence of 0·075–0·15 mg. of phytate phosphorus (i.e. the range used for preparation of the calibration curve) are shown in Fig. 2. No measurable effect was obtained with 0·1 mg. of orthophosphate. In the presence of 0·4 mg. of orthophosphate phosphorus the error is less than 5% and with 2·0 mg. of orthophosphate phosphorus the method as described is inapplicable.

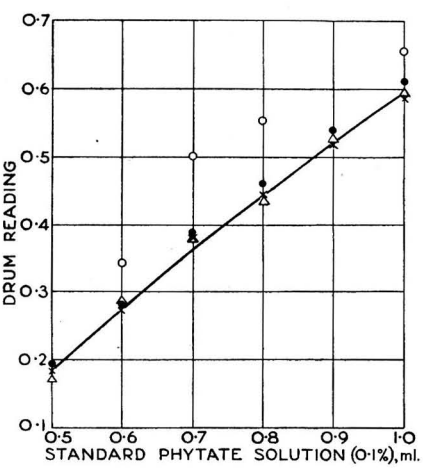

FIG. 2.—*Effect of orthophosphate on proposed calibration curve*

× No orthophosphate phosphorus
△ 0·1 mg. of orthophosphate phosphorus per final 25 ml.
● 0·4 mg. of orthophosphate phosphorus per final 25 ml.
○ 2·0 mg. of orthophosphate phosphorus per final 25 ml.
1 ml. of standard phytate solution = 0·155 mg. of phytate phosphorus.

(*b*) *Other anions.*—Chloride, sulphate and the common plant acids were tried (Table II). Only oxalate interfered seriously.

Table II

Interference of various anions; conditions as in preparation of standard curve, 0·7 ml. of standard phytate

Anion	Error produced in stated concn., %		
	0·1N	0·01N	0·001N
Chloride	20	Nil	—
Sulphate	35	3	—
Tartrate	16	Nil	—
Citrate	7	Nil	—
Malate	10	Nil	—
Oxalate	—	—	70

(*c*) *Sugars.*—Even in a final concentration of 1·8%, which is absurdly high, glucose, fructose and sucrose had little effect on the colour.

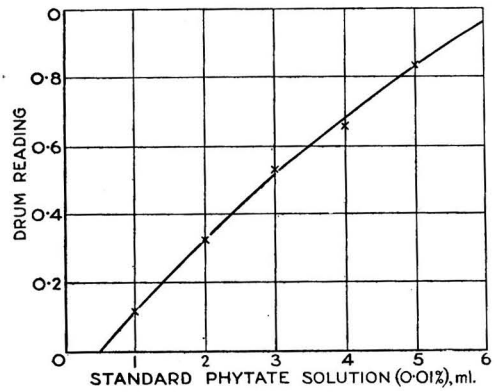

FIG. 3.—*Calibration curve prepared in aqueous alcohol*

Use of alcoholic medium

For given concentrations of iron, thiocyanate and acid the colour intensity is greater in the presence of miscible solvents such as alcohol and acetone. Woods & Mellon[6] state that the effect of various anions, notably fluoride and oxalate, on the intensity of the ferric thiocyanate colour is much less in aqueous acetone than in purely aqueous solution. Leeper[7] says that orthophosphate behaves similarly. Alcohol may be expected to have an effect similar to that of acetone. At one stage in the development of the method described above it was thought that interference by phosphate might be prohibitive. An attempt was therefore made to prepare a calibration curve relating colour intensity to phytate-phosphorus content in a medium containing 50% (v/v) of industrial methylated spirit (95% alcohol). The calibration curve (Fig. 3) was prepared as described above for the aqueous medium except that (1) sufficient 2N-nitric acid was added to make the final acidity 0·2N, (2) the quantity of dilute iron solution added was 2·5 ml., (3) 12·5 ml. of 95% alcohol was included in the final 25 ml. and (4) the solution was allowed to stand 15 minutes, but not heated before measurement of the colour intensity.

This technique was not applied to the determination of phytate phosphorus in dried peas because the purely aqueous method eventually proved adequate. The miscible solvent increases rather than decreases the effect of phytate on the ferric thiocyanate reaction. On the reasonable assumption therefore that alcohol, as does acetone, decreases the effect of phosphate and other anions on the ferric thiocyanate reaction, the use of an aqueous alcoholic medium may provide increased sensitivity and specificity should this be required.

Application to dried peas

Extracts from dried peas would not be expected to contain sufficient quantities of interfering substances to detract seriously from the validity of the results.

Procedure.—Grind the sample as finely as possible. The finer this can be done the less is the possible sampling error. Nevertheless a hand coffee-grinder has been found suitable for routine determinations although a sample almost the consistency of a flour was used for the experimental work.

Weigh 5 g. and mix with 50 ml. of 0·5N-nitric acid. If the sample is at all coarse it should then be set aside overnight, otherwise proceed immediately. Stir or shake for three hours, add 150 ml. of water and centrifuge or filter the extract to clarify it as much as possible. Into two boiling-tubes of 100 ml. capacity measure duplicate 2-ml. aliquots of the extract, add 9·5 ml. of 0·5N-nitric acid and 7·5 ml. of water. Then add 5 ml. of dilute iron solution, immerse in a boiling-water bath and continue as in the preparation of the standard curve. A turbidity 'blank' should be made in an identical manner, but with an extra 1 ml. of water in place of the ammonium thiocyanate. Add the optical density of this blank to the average sample reading. Refer the figure thus obtained to the calibration curve to find the phytate content of the 2-ml. aliquot. If it does not fall in the range covered by the calibration curve repeat the determination with appropriate aliquots of the extract. All determinations should be done in duplicate and expressed as the mean.

Results and conclusions

A series of determinations were made on one sample of dried peas to ascertain the reproducibility of the results (Table III).

The phytate in the first extract was determined in triplicate to show what variations might be expected in a single extract.

On a further eighteen samples the phytate was determined by both the method described above and by that of Pringle & Moran. These results are compared in Table IV.

Although the standard deviation recorded in Table III is about 5% the results from a single extract have always been much closer than this whenever more than one determination

Table III

Reproducibility of results on single sample of dried peas

Extract number	Phytate P, mg./100 g. of sample	Mean	Standard deviation
1	187, 187, 189		
2	183		
3	185		
4	165	175	8·4
5	165		
6	175		
7	171		
8	171		

has been made on it. In fact, as with the figures for extract number 1 in Table III, the difference between such results is usually no greater than that expected from one colour measurement to the next. It seems that most of the variation is accounted for by some factor

Table IV

Comparison of methods for phytate phosphorus determination

Phytate P, mg./100 g. of sample		100 A/B
Present method (A)	Pringle & Moran method (B)	
261	279	94
253	258	98
261	270	97
274	282	97
266	285	94
255	279	92
255	264	97
280	274	102
285	279	102
277	279	99
187	198	95
180	168	107
202	189	107
280	261	107
274	264	104
280	279	100
251	248	101
280	289	97

other than the actual reactions on which the colour intensity depends—the turbidity correction for example.

The agreement between the results obtained by the two methods is satisfactory since both depend on measurement of colour intensity. There is no real tendency for one method to give higher results than the other.

It is concluded that the method evolved is suitable for the determination of phytate phosphorus in dried peas and gives results correct to $\pm$ 5%. The method has been applied to numerous samples of dried peas and the results will be reported later in this series.

Acknowledgments

The author wishes to thank Dr. F. G. Peers of the Research Association of British Flour Millers, Cereals Research Station, St. Albans, for the gift of a sample of ' phytin ' which was

originally supplied by Ciba Laboratories Ltd., Horsham, Sussex. He also wishes to thank Mr. W. B. Adam and Dr. D. Dickinson for advice and encouragement in the work and in the preparation of the paper.

The Fruit and Vegetable Canning and Quick Freezing Research Association
Chipping Campden
Glos.

Received 23 August, 1954

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THE NATURE OF BACTERIAL LIPIDS IN THE RUMEN OF HAY-FED SHEEP

By G. A. GARTON and A. E. OXFORD

The lipids extracted from the mixed 'free' rumen micro-flora of two hay-fed sheep consisted of 39·2% of phospholipids, 38·2% of neutral fat, 12·4% of lower fatty acids (probably rumen fermentation products), 10·1% of unsaponifiable matter and 0·1% of steam-volatile, neutral solid. The 'true' lipids amounted to 9% of the dry weight of the bacteria. The neutral fat was noteworthy for the relatively high mean molecular weight (312·0) of its component acids. No linoleic or linolenic acid was detected in the neutral fat or phospholipids. The significance of this with respect to the host animal is discussed. The N : P ratio of the phospholipids indicated the presence of mono- and di-aminophosphatides. The unsaponifiable matter contained carotenoid pigments (probably xanthophylls) and 16·1% of a steroid-like substance, possibly $C_{27}H_{48}O_2$, m.p. 130–132°, precipitable by digitonin, but not identical with the hydrated form of cholesterol.

Introduction

It is generally agreed that, apart from the products of their biochemical activity, the rumen bacteria themselves have a definite and indisputable food value to the host animal.[1, 2] This conclusion refers to the ox in particular, but probably holds also for the sheep (cf. Usuelli & Fiorini;[3] Johnson *et al.*[4]). The amino-acid composition of the rumen bacterial protein of the sheep has recently been determined by Holmes, Moir & Underwood.[5] Much also is already known about sheep's rumen bacterial polysaccharides, both with respect to overall composition[6] and also to the chemical make-up of individual carbohydrates elaborated by certain true rumen bacterial species (see for instance Hobson & MacPherson[7]). On the other hand, knowledge concerning the properties and chemical nature of rumen bacterial lipids for any ruminant seems to be entirely lacking. Judging from what is already known about the chemical composition of the lipids of some individual bacterial genera (e.g. mycobacteria, as revealed by the extensive investigations since 1927 of R. J. Anderson & co-workers, and *Lactobacillus* spp., as recently determined by Hofmann, Lucas & Sax[8] and Hofmann & Sax[9]) it would clearly be unsafe to assume that the rumen bacterial lipids necessarily resemble those of the plant fodder. In this respect bacteria differ greatly from yeasts and micro-fungi. The present paper is concerned with an investigation into the chemical nature of the main constituents of sheep's rumen bacterial lipids when the animal is maintained on the simplest possible plant fodder, namely meadow hay exclusively. This investigation arose out of a previous survey by one of us[10] of inorganic phosphorus compounds in rumen contents, and

has been extended to cover not only bacterial phospholipids but phosphorus-free neutral fat and unsaponifiable matter also.

Experimental

Animals.—Two Cheviot wethers, each fitted with a permanent rumen fistula, were used in this work. They were maintained on a diet of 1 kg. of chopped meadow hay per animal per day, with access to water and a mineral lick.

Sampling.—Rumen contents (usually about 1 litre) were obtained by inserting a glass tube into the fistula and withdrawing the contents by suction. Samples were taken approximately every other day for a period of several months.

Preparation of bacteria.—The rumen contents (1 or 2 litres at a time) were strained through two sheets of copper gauze to remove large hay particles and then centrifuged at 2000 r.p.m. for 10 min. to separate plant particles and ciliate protozoa. The green supernatant liquor was then centrifuged in a Sharples centrifuge and the deposited sludge collected. This was resuspended in a little water and recentrifuged. It was considered inadvisable to attempt to wash the bacteria thoroughly for fear of losing the smaller organisms on recentrifuging. Microscopic examination of the resultant sludge showed it to consist almost entirely of bacteria or micro-organisms resembling bacteria; no recognizable ciliate protozoa and only a very few irregular-shaped particles were found. The bacterial sludges from the many preparations were stored in bulk at $-20°$ until about 700 g. had been collected.

The bulked sludge was then dried in a vacuum spin freeze drier to give 110 g. of a pale-brown powder; pilot experiments showed that the yield of dried material was 0·5–1·0 g. per litre of rumen contents.

General analytical methods and reagents.—Iodine values were determined as described by Hilditch.[11] Nitrogen was estimated by the micro-Kjeldahl procedure and phosphorus according to the method of Allen[12] after wet-ashing. Absolute ethanol was distilled over potassium hydroxide and zinc dust, and ether over reduced iron, to remove peroxides. The hexane used was *n*-hexane, free from aromatic hydrocarbons (British Drug Houses Ltd.).

Extraction of lipids

Preliminary work showed that prolonged extraction of the freeze-dried bacterial preparation with ether in a Soxhlet apparatus removed only small amounts of lipid (2·8% on a dry-weight basis), but that when a mixture of ethanol and ether was used much more soluble material could be extracted. Accordingly, the dried preparation (97·0 g.) was heated under reflux for 2 h. with 1 litre of a 3 : 1 (v/v) ethanol/ether mixture. The extraction mixture was filtered by suction and the extraction with ethanol/ether repeated twice. The combined extracts were carefully distilled almost to dryness and then the last traces of solvent and moisture removed *in vacuo* on a warm-water bath, leaving 16·3 g. (16·8%) of brown-green, semi-solid extract of iodine value 23·4. The lipid-free bacterial residue was found to contain 55% of crude protein (N × 6·25) and only 0·3% of cellulose as determined by the method of Crampton & Maynard.[13]

Fractionation of lipids

The crude ethanol/ether extract (9·30 g.) was steam-distilled and the non-volatile residue further separated into salts soluble in water and lipid soluble in a light petroleum/ether mixture. The lipid was further fractionated into acetone-insoluble material (phospholipids), neutral fat and unsaponifiable matter. Details of these separations and the examination of each fraction are described below and are summarized in Table I.

(*a*) *Steam-volatile material.*—When steam-distilled the first condensate was acidic to litmus and so the distillation was continued for 2·5 h. until no further volatile acid was being collected. The total condensate (380 ml.) was made up to 500 ml. and aliquots were titrated against 0·1N-sodium hydroxide solution. The acidity of the total steam-volatile acids was equivalent to 7·06 ml. of N-alkali (0·42 g. calculated as acetic acid). During the steam-distillation a very small amount (12 mg.) of a non-acidic, white solid collected in the condenser.

(*b*) *Non-steam-volatile material.*—The residue in the steam-distillation apparatus was

Table I

Fractionation of the ethanol/ether extract (9·30 g.) of dried rumen bacteria

Fraction	Chemical nature	Weight, g.	Per cent. of ethanol/ether-soluble material	Per cent. of true lipids (i.e. excluding water-soluble salts)	Per cent. of dry weight of bacteria (excluding water-soluble salts)
Steam-volatile	Lower fatty acids	0·60*	6·5	12·4	1·1
	Neutral solid	0·01	Trace	0·1	Trace
Acetone-insoluble	Phospholipids	1·91	20·8	39·2	3·5
Acetone-soluble	Neutral fat	1·87†	20·2	38·2	3·4
	Unsaponifiable	0·49†	5·4	10·1	0·9
Water-soluble, non-steam-volatile	Salts of steam-volatile acids (acetic, propionic and butyric)	4·42	47·1	—	—

* By difference: calculated as acetic acid (see text) = 0·42 g.
† Corrected for amount used in determination of iodine value of the acetone-soluble lipids

extracted with 6 × 100 ml. of a mixture of 3 vol. of A.R. light petroleum (b.p. 40–60°) and 1 vol. of ether. The pooled extracts were dried over anhydrous sodium sulphate, filtered and the solvents removed, leaving 4·27 g. of viscous, brown material. The straw-coloured solvent-extracted aqueous solution, which was neutral to litmus, was evaporated to dryness to give a pale-brown, crystalline solid (4·42 g.).

(i) *Examination of water-soluble material.*—The crystals, which contained no nitrogen, gave an ash content of 38·7%. The material (2·31 g.) was steam-distilled after acidification with sulphuric acid and the volatile fatty acids were recovered from the distillate by ether extraction. When examined on the gas–liquid chromatogram[14] the major component acids (in moles-%) were acetic (59%), propionic (28%) and *n*-butyric (10%).

(ii) *Acetone fractionation of non-volatile lipids.*—The lipids were dissolved in hexane (20 ml.) and the solution was poured slowly, with stirring, into 300 ml. of ice-cold, dry acetone containing 10 drops of a saturated ethanolic solution of magnesium chloride. The resulting brown, flocculent precipitate of crude phospholipids was removed by centrifuging and redissolved in hexane, the solutions were combined and the solvent was removed under nitrogen on a warm-water bath, leaving a brown, brittle solid (1·91 g.). The supernatant acetone solutions were combined and evaporated carefully to dryness *in vacuo* to give 2·36 g. of brown-green fat.

Examination of phospholipids

The brown, solid phospholipids had an iodine value of 29·3. The nitrogen content was 1·78% and the phosphorus content 2·5%, giving an atomic N : P ratio of 1·6 : 1·0. The material (1·80 g.) was saponified with 15 ml. of ethanolic 0·5N-potassium hydroxide for 2 h. After acidification with sulphuric acid, the fatty acids (0·62 g.) were recovered by ether extraction and found to have iodine value 34·3 and saponification equivalent 296·2. The aqueous liquor from which the fatty acids had been extracted was neutralized with sodium hydroxide and evaporated almost to dryness: the resulting partially crystalline material gave a positive Denigès test for glycerol and was non-reducing to Benedict's reagent.

Alkali-isomerization of the mixed fatty acids followed by spectrophotometric examination[15] failed to reveal the presence of linoleic or linolenic acid.

Examination of acetone-soluble lipids

This material, which had an iodine value of 39·8, was found to contain no nitrogen and only 0·3% of phosphorus, showing that phospholipids had been effectively separated by acetone precipitation.

The lipids (2·10 g.) were saponified by refluxing with 50 ml. of ethanolic 0·5N-potassium hydroxide for 2 h. Water (150 ml.) was added and the unsaponifiable matter removed by

extraction with 3 × 75 ml. of hexane. The hexane extract was washed with 3 × 50 ml. of water and the yellow solution dried over anhydrous sodium sulphate. Removal of the hexane left 0·44 g. of a pale-yellow, waxy solid (20·95% of the acetone-soluble lipids).

The aqueous layer containing the soaps was acidified with 10N-sulphuric acid (4 ml.) and the fatty acids were extracted with 4 × 100 ml. of hexane. The pooled hexane solutions were washed with water and dried over anhydrous sodium sulphate. The hexane was removed by distillation to yield pale-brown, crystalline fatty acids (1·40 g.). No lower fatty acids were apparently present in esterified form, since no odour characteristic of these acids was detected when the solution of soaps was acidified.

Identification of glycerol as tribenzoate.—The aqueous solution from which the fatty acids had been extracted was neutralized with sodium hydroxide and evaporated to dryness on the water bath. The residue was extracted several times with boiling ethanol (a total of 20 ml.). The ethanol was removed by distillation and the residue was benzoylated by the Schotten–Baumann method with benzoyl chloride and sodium hydroxide. A pale-yellow, gummy material was formed which could be induced to crystallize only after several treatments with charcoal in boiling 90% (v/v) aqueous ethanol, filtering and leaving at 0° for several weeks. The crystals of glyceryl tribenzoate had m.p. 73–74° and mixed m.p. 74·5° with an authentic specimen of the compound (m.p. 75°). No other polyhydroxy-compound was detected.

Properties of fatty acids.—The acids comprised a pale-brown, hard, crystalline material of iodine value 23·8 and saponification equivalent 312·0. When treated as described for the phospholipid fatty acids, no conjugatable dienoic or trienoic acids were detected spectrophotometrically.

Composition of unsaponifiable matter.—The unsaponifiable matter, which had an iodine value of 55·9, was readily soluble in hexane, benzene and ether, but relatively insoluble in cold methanol and ethanol. It gave a strongly positive Liebermann–Burchard reaction. The Tortelli–Jaffé and Rosenheim reactions given by sterols of the ergosterol type were negative. An attempt was therefore made to crystallize any sterol(s) present by dissolving the unsaponifiable matter (0·5 g.) in methanol (10 ml.) and leaving the solution at — 1° for 24 h. The resulting crystals (a mixture of small plates and needles) gave a positive Liebermann–Burchard reaction, but melted indefinitely at 60–70°. Digitonin was therefore used to precipitate the sterol-like material, as described below.

(*a*) *Isolation of a 'sterol' by precipitation with digitonin.*—A portion of the unsaponifiable matter (105 mg.) was dissolved in hexane (0·5 ml.) and to this solution was added absolute ethanol (2 ml.) and the solution heated in the water bath. To the hot solution was added a solution of 101 mg. of digitonin (British Drug Houses Ltd.; mol. wt. 1215) in hot 95% (v/v) aqueous ethanol (5 ml.). The mixture was stirred and the resulting precipitate of digitonide allowed to stand for 2 h. at room temperature. It was then collected and washed (3 × 5 ml. of ether) in the centrifuge tube. The washed digitonide (94·4 mg.) was decomposed by heating under reflux with freshly distilled pyridine (3 ml.) for 1 h. at 80–90°. The pyridine was removed *in vacuo* and the residual solid triturated three times with warm ether (5 ml.). The ether extracts were combined and centrifuged, and the supernatant solution was evaporated to dryness under nitrogen to give rosettes of small, colourless needles. Residual traces of pyridine were removed by allowing the crystals to remain overnight in an evacuated desiccator over concentrated sulphuric acid. The product (16·9 mg., 17·9% of the weight of the digitonide) gave intense Salkowski and Liebermann–Burchard reactions resembling those given by cholesterol, but did not give the Tortelli–Jaffé reaction. Recrystallization from 90% (v/v) aqueous methanol gave small colourless needles, m.p. 130–132°, not raised by a second recrystallization. Mixed with anhydrous or monohydrated cholesterol (m.p. 146°), the m.p. was depressed to 119·5–120·5°. The substance showed no measurable optical rotation in chloroform (*l*, 0·5 dm.; *c*, 1·85%). (Found, after drying to constant weight *in vacuo*: C, 80·15; H, 12·0%; *M* (cryoscopic in camphor), 400; active H, 0·37%; $C_{27}H_{48}O_2$ requires C, 80·1; H, 12·0%; *M*, 404; 1 active H, 0·25; 2 active H, 0·495%.) (The microanalyses were carried out by Weiler & Strauss, Oxford.)

Examined in the Beckman spectrophotometer a solution of the substance in hexane showed no selective absorption in the ultra-violet region of the spectrum, but solutions in hexane and ethanol fluoresced blue and pale green respectively when irradiated by an ultra-violet lamp. As an additional proof that the substance was not hydrated cholesterol, an attempt was made to prepare a dibromide from 5 mg. of the purified substance by the method of Schwenk & Werthessen.[16] None was obtained, although under the same conditions an almost quantitative yield of 5 : 6-dibromo-3-cholestanol was obtained from 5 mg. of authentic cholesterol.

(*b*) *Identification of pigments.*—A further amount of crude lipid (6·47 g.) was saponified directly and the unsaponifiable matter extracted essentially as already described for the treatment of the acetone-soluble lipids to yield a pale-yellow, waxy solid, which resembled the unsaponifiable matter of the acetone-soluble lipids in its solubility characteristics.

A portion of the unsaponifiable matter (0·287 g.) dissolved in hexane (1 ml.) was chromatographed on a column of alumina (Grade 'O', Peter Spence & Co., Widnes), weakened in absorptive capacity by treatment with methanol as described by Goodwin & Taha.[17] The column was developed first with hexane, then with hexane containing 1% (v/v) and 2% (v/v) of ether, when two main yellow bands separated. The first band was readily eluted with acetone containing 2% of ether, but the second band was not removed until pure ether was used. All the fractions collected gave a faintly positive Liebermann–Burchard reaction, but the main bulk of the sterol-like material was not eluted until methanol was used as developing solvent.

The yellow fractions were evaporated to dryness in a current of nitrogen, dissolved in hexane and examined in the Beckman spectrophotometer. Both solutions showed λ $\lambda_{max.}$ 444 mμ and 472 mμ, with minor *cis*-peaks at 420 mμ. They were both hypophasic in a mixture of 90% (v/v) aqueous methanol and light petroleum, and so it was concluded that the pigments were xanthophylls, probably differing in the number of hydroxyl groups.

Discussion

The lipids examined in the present preliminary study were derived mostly from the many bacterial species which are found free in the rumen liquor of the mature, hay-fed sheep. They would not be representative of the 'bound' bacteria (mostly cellulolytic anaerobes) adhering closely to the plant fibres, since especial pains were taken to exclude plant cellulosic material. The saccharolytic bacteria present in the rumen of one of the animals used in this work were examined by Mann, Masson & Oxford[18] and found to include *Streptococcus bovis* and other Gram-positive cocci (including micrococci), Gram-negative cocci (including a large sarcina-like organism) and small Gram-negative rods, only a small proportion of which were coliforms. It is probable that the rumen micro-flora of the other sheep was essentially similar. Mycobacteria and lactobacilli, the only two bacterial groups whose lipids have been investigated in detail by other workers, were not represented.

That no food particles were present in the bacterial preparations was indicated by microscopic examination and confirmed by the almost complete absence of cellulosic material. Further confirmation was the failure to detect any conjugatable dienoic or trienoic fatty acids in the bacterial lipids; such acids are characteristic of grass fats.[19] The apparent absence of cholesterol indicates that no cellular material of host-animal origin (e.g. desquamated rumen epithelial cells) was present in significant amounts in the dried bacteria.

The composition of the ethanol/ether extract of the dried organisms given in Table I shows that, in addition to the usual classes of lipids (neutral fat, phospholipids, free fatty acids and unsaponifiable matter), the extract contained 47% of ethanol-soluble salts of lower steam-volatile fatty acids. These salts, mainly acetate, propionate and butyrate, were doubtless mostly, if not entirely, derived from the rumen liquor entrained in the bacterial sludge.

On a salt-free basis the true lipids comprised nearly 9% of the dry preparation (cf. 2·5% for *Lactobacillus arabinosus*[8]) and contained neutral fat and phospholipids as the main components, each of which accounted for nearly 40% of the total. Both were shown to contain glycerol, though it was not established that glycerol was the only polyhydric alcohol present.

As judged by the N : P ratio, the phospholipids comprised a mixture of mono- and di-amino-phosphatides. As with *Lb. arabinosus*[8] no linoleic or linolenic acid was detected in either the neutral fat or the phospholipids. Assuming that the sheep requires one or both of these 'essential' fatty acids it must depend wholly on its food to supply its requirements, unless of course some of the rumen ciliates contain these acids. As already mentioned, grass fats are a rich source of C_{18} unsaturated fatty acids, though it seems possible that some of these dietary acids may undergo hydrogenation by micro-organisms in the rumen, since Reiser[20] has shown that saturation of linolenic acid occurs when linseed oil is incubated for several days with rumen contents. Very recently Hartman, Shorland & McDonald[21] have reported the presence of about 9% of *trans*-isomers of unsaturated fatty acids in the fatty acids isolated from the rumen contents of pasture-fed sheep; since no appreciable amounts of *trans*-acids were found in the pasture lipids, their occurrence in the rumen is attributed to the action of micro-organisms on the unsaturated acids of the food. Another possibility is that the rumen bacteria contain *trans*-acids (cf. Hofmann *et al.*[8, 9], who conclude that lactobacillic acid, a methylene-octadecanoic acid found in the lipids of *Lb. arabinosus* and *Lb. casei*, probably has the *trans*-structure).

The saponification equivalent (mean molecular weight) of the neutral-fat fatty acids is notably high (312·0), indicating that long-chain acids, e.g. lignoceric acid, such as are found in the lipids of certain acid-fast bacilli[22] may be present. It is hoped to study the nature of these fatty acids in more detail later.

The free steam-volatile, water-soluble fatty acids, which formed about 12% of the lipids, almost certainly represented the end-products of the fermentation of carbohydrates and amino-acids by the rumen flora.

The unsaponifiable material, comprising 10% of the true lipids, was found to contain as much as 16%, i.e. more than 1% of the total lipids, in the form of a digitonin-precipitable substance (or possibly mixture of chemically similar substances) of approximate empirical formula $C_{27}H_{48}O_2$ (but with probably only one active hydrogen as OH) which could not be identified with a known sterol. Although melting at 130–132°, the microbial 'steroid' was certainly not identical with cholesterol monohydrate of the same empirical formula ($C_{27}H_{46}O,H_2O$). It is not entirely excluded that the substance may be a terpenoid alcohol. The absence of optical activity may perhaps be more in harmony with this concept than with a true polycyclic sterol ring structure. Further, bacteria are usually regarded as sterol-free micro-organisms without exception. However, the so-called rumen 'bacteria' here investigated, although free from the larger ciliate protozoa, might nevertheless have contained small flagellate protozoa, or even very small representatives of the ciliate *Entodinium*, as well as minute flagellated micro-organisms of uncertain affiliation such as *Selenomastix* (*Selenomonas*) *ruminantium*[23] which are often abundant even in the hay-fed sheep's rumen. The sterols of these minute animals have never been investigated.

The pigments of the rumen bacteria were shown to be xanthophylls. A microbial origin for these is not impossible, since carotenoid pigments are known to occur in *Corynebacterium* spp.,[24] a genus that might well be represented in the rumen (cf. Gutierrez[25]). Hungate[26] and Sijpesteijn[27] have isolated yellow cellulolytic cocci from the rumen, which, according to the latter author, occur in vast numbers in both sheep and cattle. The chemical nature of the bacterial pigment has not, however, been determined in this instance.

Acknowledgments

The authors are indebted to their colleague Dr. D. M. Walker for the cellulose determination, Dr. E. F. Annison (A.R.C. Institute of Animal Physiology, Babraham, Cambridge) for the gas–liquid chromatography, and to Mr. W. R. H. Duncan and Mr. H. Stewart for their technical assistance.

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Received 6 August, 1954

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THE COMPOSITION OF WHALE-MEAT MEALS OF VARIOUS GRADES

By H. PRITCHARD and M. CAWTHORNE

Samples representing the range of whale-meat meals most often used in this country were examined in the laboratory to assess the variation of their composition. Besides the normal analytical figures required by the Fertiliser & Feeding Stuffs Regulations, the albuminoid protein, as given by copper precipitation, rate of digestion of protein with pepsin, and some of the members of the vitamin-B group were also determined.

Although no official method of grading exists, the whaling companies and merchants designate whale-meat meals with protein content from 80 to 85% as Grade A, those containing from 40 to 65% of protein as Grade B, and meals derived mostly from bone as Grade C.

The albuminoid nitrogen was as high as 97·2% of the total crude nitrogen in Grade-A meals, as was the rate of digestion with pepsin. Where high ash contents occurred, as in Grade-B and Grade-C meals, however, both these figures were substantially lower.

The results obtained for vitamins of the vitamin-B group indicated that a wider variation in potency existed than had previously been suspected; one case of Grade-A whale-meat meal had a nicotinic acid content as high as 171 μg./g., but a sample of Grade C contained only 15 μg./g.

Whale-meat meals are accepted as a valuable source of nutrients to livestock, but grading and quality are important factors to be considered in their selection.

The bulk of whale meat used in this country is processed in the Southern Hemisphere, either in floating factories or on land stations during the southern summer, and is brought to this country to be employed in provender milling. Although various types of whale-meat meal are available, ranging from pure meat meals to bone meals, the tendency is to place them all in the same category, ignoring those variations in quality and source which may influence their nutritive qualities.

No hard and fast method of grading whale-meat meal is available, but between the producer and those firms marketing it a system of grading from A to C is in force. The difference between each of the grades tends to be vague, however, and, as methods of production

are improved, eventually only either meat meals or bone meals will be produced. In general, it may be said that Grade-A whale-meat meals are pure meat meals with low mineral contents and a protein content from 80 to 85%.

Grade-B whale-meat meals are essentially meat and bone-meal mixtures. The protein content of this grade varies between 40 and 65% and the meals contain higher levels of oil and ash than those of Grade A. It is in this category that the widest variation in analysis occurs.

Finally, Grade-C whale-meat meals are mainly bone meals, but they contain an appreciable quantity of protein and a fair quantity of oil. The protein content is normally about 20%.

To assess the quality of the various grades of whale meat available in the United Kingdom, samples were drawn from a large number of sacks from each grade when the main deliveries to this country were completed. The samples were used to prepare average samples weighing about 4 lb., which were then ground and quartered to produce those used for the tests. Altogether seven samples were obtained, representing the following grades and sources:

Sample	Grade	Source
5361	A	British floating factory
5362	A	,, ,, ,,
5363	A	,, ,, ,,
5364	A–B	South Africa
5365	A–B	,, ,,
5366	B	Australian
5367	C	British floating factory

Samples Nos. 5361–5363 were high-quality whale-meat meals made from freshly killed whales on board the floating factory. The meat was entirely separated from the bone and partly separated from large sinews and connective tissue, coagulated by heating for 4–5 minutes at about 90°, pressed, and then dried in a rotating oil-fired drier. The whales mainly dealt with were Fin, Blue, and a few Sperm.

Samples 5364 and 5365 represented meals produced on a land station in South Africa and were graded A–B because they are less regular in their composition and mode of production than those graded A. Two methods of treatment were given. One was similar to that described above, but coke-fired rotary driers were used instead of oil-fired rotary driers. The time that elapsed between the death of the whale and processing was much longer, namely 18–24 hours after death, and the species of whales treated were Sei, Sperm, and a few Fin. In addition to these, some meals were produced by cooking meat and bone together for 8 hours at 60-lb./sq. in. steam pressure. At the end of this period the solid matter was roughly sorted to remove the bone, and the residue was dried in the rotary drier as for whale meat. Sample 5366 was probably produced in this way, and finally sample 5367 was purely a bone meal.

The method of testing was confined to laboratory assessment covering the quality and enzymic digestibility of the proteins and the level of content of members of the vitamin-B group.

Analysis of the feeding constituents

The tests carried out in this section were, as far as possible, those officially accepted in the Fertiliser and Feeding Stuffs Act Regulations.

The assessment of the true protein or albuminoid protein was carried out by the official method laid down by the Association of Official Agricultural Chemists,[1] by using copper. The ease of digestion of the protein present in the meals was assessed by treating the meals with pepsin for a certain period and estimating the residual undigested protein.

The analytical figures obtained are shown in Table I.

A further examination of the constituents was carried out separately and Table II shows the results obtained on the examination of the oil which was isolated from each of the samples individually.

It can be seen that the oil present in some of the samples shows, by the peroxide value, signs of a high degree of oxidation. This is particularly evident in samples 5364 and 5365.

Table I

Sample	Grade	Moisture, %	Oil, %	Ash, %	Total crude protein, %
5361	A	9·36	3·00	2·33	86·54
5362	A	8·84	3·80	2·40	82·10
5363	A	7·40	7·52	3·27	80·10
5364	A–B	9·21	4·04	2·80	82·83
5365	A–B	9·90	4·92	3·01	84·96
5366	B	6·63	13·87	21·55	56·86
5367	C	3·57	15·01	58·99	18·70

Table II

Sample	Grade	Oil, %	Free fatty acids as oleic, %	Peroxide value
5361	A	3·00	3·83	13
5362	A	3·80	9·07	Nil
5363	A	7·52	—	—
5364	A–B	4·04	17·03	49·5
5365	A–B	4·94	37·3	33
5366	B	13·87	8·28	18·5
5367	C	15·01	14·9	8·5

Further, the free fatty acid content of these samples was also very high, which suggests that a considerable period had elapsed between the death of the whale and of the production of the meal. This is likely to occur in land stations. Probably the oil that indicates the best condition was that found in sample 5361, although the least oxidized oil was that obtained in the meal of sample 5362 which had no peroxide value.

The true or albuminoid protein was estimated by using the copper hydroxide method, and the results of the examination are contained in Table III.

Table III

Sample	Grade	Crude protein, %	Crude protein nitrogen, %	Ammoniacal nitrogen, %	Total protein nitrogen, %	As protein, %	Albuminoid or true protein, %	True protein in total protein, %
5361	A	86·54	13·85	0·04	13·81	86·2	82·40	95·8
5362	A	82·1	13·12	0·10	13·02	81·3	74·20	91·3
5363	A	80·10	12·78	0·06	12·72	79·6	68·80	86·7
5364	A–B	82·83	13·25	0·09	13·14	82·2	79·80	97·2
5365	A–B	84·96	13·60	0·09	13·51	84·5	77·20	91·5
5366	B	56·86	9·10	0·05	9·05	56·6	46·80	84·3
5367	C	18·70	2·99	0·09	2·9	18·1	12·42	68·7

It can be seen that the albuminoid protein is low in those meals containing a high ash content, suggesting that some of the crude protein nitrogen is provided by glue. This figure would also tend to be low if a quantity of nitrogen-containing liquor, resulting from the treatment of blubber and meat, were to be dried with the meal to increase its apparent protein content.

A very high portion of the protein present in most of these meals is there as true protein and hence will have a high value when nutrient properties are being assessed. The highest quantity was obtained in the Grade A–B sample from South Africa, but the value of 95·8% shown for sample 5361 from a British floating factory is very high.

Among the genuine whale meats, that is those containing a small quantity of ash, and appearing to come from whale meat alone, sample 5363 gave the lowest figure; all the others were over 90%.

None of the samples contained a high quantity of ammoniacal nitrogen, indicating that the meals had not been prepared from decomposing or bad meat. Again this test showed that sample 5361 was better than any of the others.

In order to obtain some idea of the comparative ease with which the various whale meats

were digested, the following test was carried out. A 1-g. portion of the sample was suspended in 92 ml. of water, 8 ml. of a 2·5M-solution of sodium acetate added, and the pH adjusted to 2 by the addition of hydrochloric acid. To this mixture 0·4 ml. of a 10% suspension of B.P. pepsin was added, and the mixture incubated at 40° for 16 hours. Then the mixture was filtered and the residue in the filter paper washed with water. The protein content of the residue was determined by the Kjeldahl digestion, and the amount of material digested determined by deducting the undigested protein from the total crude protein in the sample and expressing the difference in terms of 100% of the initial crude protein. The results are shown in Table IV.

Table IV

Comparative degree of digestion with the enzyme pepsin after 16 hours at 40°

Sample	Grade	Crude protein, %	Undigested after 16 h., %	Initial crude protein digested in 16 h., %
5361	A	86·54	11·66	86·6
5362	A	82·10	7·39	91·0
5363	A	80·10	5·43	93·2
5364	A–B	82·83	12·38	85·1
5365	A–B	84·96	5·07	94·0
5366	B	56·86	16·56	70·9
5367	C	18·70	8·34	55·4

It is evident that all the normal whale meats were highly digestible, and only the two containing a large quantity of bone were of low digestibility.

The two grades of whale meat labelled B and C had high ash contents, consequently the phosphates were determined on these two samples. The results were as follows:

		P_2O_5, %	Calcium phosphate, %
Sample 5366	Grade B	8·76	19·13
,, 5367	,, C	21·38	46·70

Accessory food factors

The accessory food factors most likely to be found in the material that is being dealt with are the members of the vitamin-B group. These, if the original source of the meals contained a fair amount, would still be retained in large quantity, provided that the treatment had not been too harsh during either preparation or storage.

It has already been noted that whale-meat meal contains members of the vitamin-B group[2] and in order to determine the variation in the vitamin-B content of the various grades of whale meat and the value of each grade, six members of the vitamin-B group were determined by microbiological means. These were riboflavin, nicotinic acid, pantothenic acid, pyridoxine, inositol and vitamin B_{12} (cobalamin). The methods employed in this investigation were those recently published.[3] It was decided that of the determinations mentioned, those for thiamine and choline need not be carried out, and the assays made were limited to the range mentioned above. The results are given in Table V.

Table V

Sample	Grade	Riboflavin, μg./g.	Nicotinic acid, μg./g.	Pantothenic acid, μg./g.	Pyridoxine, μg./g.	Inositol, μg./g.	Vitamin B_{12}, μg./g.
5361	A	4·2	73·5	17·7	—	313	0·02
5362	A	4·5	89·4	3·5	6·6	250	0·07
5363	A	6·4	171·3	4·3	—	204	0·09
5364	A–B	5·2	125·0	7·5	5·0	135	0·09
5365	A–B	5·8	103·7	8·6	—	107	0·11
5366	B	1·6	47·7	3·2	1·2	58	0·07
5367	C	0·4	15·2	1·3	1·0	17	0·01

It can be seen from these results that the figures obtained are similar to those previously reported, but the results obtained on the nicotinic acid, vitamin B_{12} and inositol assays indicate

a wider variation than had previously been suspected. It is evident that whale-meat meals may contain large quantities of nicotinic acid, in fact more than that which had been found in the past in fish solubles. This is true mainly in samples Nos. 5363 and 5364 from the British floating factory and from South Africa. Further, these two samples and sample 5365 contained higher quantities of vitamin B_{12} than did the remaining samples. For pantothenic acid and inositol, however, sample 5361 shows very high figures, although the riboflavin and vitamin B_{12} for this sample have a tendency to be low. The pyridoxine assays were anomalous and, in three cases, repeated assays would not yield a result, since the test organism (*Neurospora*) spored in the solutions.

Discussion

A number of workers have carried out animal tests on whale-meat meal and showed that it was a very useful form of protein supplement for animal feeding.[4–6] The nutritive value of whale products, including meat, has also recently been examined by the whaling companies.[7] The quality of the whale meat was found to vary according to the manner of treatment etc., and these factors have been closely reviewed with the object of establishing modifications that will prevent damage to nutritional value. The processes now in use reduce riboflavin, pantothenic acid and cystine contents, but leave nicotinic acid, methionine and tryptophan unaffected. Various whale products have been examined biologically at the Rowett Research Institute, Aberdeen,[8] and it was found that the whale-meat meals were of high value, having 'gross protein values' from 95 to 105% of that of casein. These workers found, as we did, that the protein associated with much bone meal was poorer than that of meat meal alone. The vitamin figures were also similar to those reported here.

Examination of the results given in the present report show that whale-meat meal varies a good deal in quality, and some discrimination should be shown in selection in order to obtain the best from this highly valuable protein supplement. The measurement of true protein (with copper), the rate of digestion with pepsin, and the examination of the oily fraction give figures of value in making an assessment of quality, so far as they indicate to what extent true meat protein is present, and how quickly the whale was processed after death.

Of the whale meats as produced at present, the analytical figures expected on a grade-A quality would be as shown in Table VI.

Table VI

Oil, %		5·0	
Free fatty acids, % on oil		8·0	
Peroxide value of oil		12·0	
Total crude protein, %		80·0	
Ash, %	about	3·0	
True protein in crude protein, %	,,	95	
Rate of protein digestion with pepsin in 16 h. at 40°, %	,,	80	
Riboflavin	above	4·0	μg./g.
Nicotinic acid	,,	80	,,
Inositol	,,	200	,,
Pantothenic acid	,,	10	,,
Vitamin B_{12}	,,	0·07	,,

Figures such as these would indicate that the whale-meat meal had received no drastic handling.

Acknowledgments

The authors wish to thank the Directors of Ocean Harvest Ltd. for providing the range of samples for examination, and Mrs. M. A. Arnold for assistance with the analytical work.

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Received 6 July, 1954; (amended manuscript) 6 October, 1954

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THE REPORTED LECITHINASE ACTIVITY OF EGG YOLK AND DRIED EGG

By C. H. LEA and R. A. L. WILSON

Acker, Diemair & Jäger have reported the presence in spray-dried whole egg and egg yolk of an enzyme capable of rapidly decomposing lecithin with the liberation of choline but not of fatty acids, and have pointed out the similarity of this enzyme to the phospholipase D* recently discovered in carrots and other vegetables.

We have been unable to confirm the existence of any considerable lecithinase activity in fresh egg yolk or in spray-dried whole egg of good quality and suggest that the observed results may have been due to the action of microbial enzymes, possibly phospholipase C, present in the samples examined by the German workers.

Recent work in the U.S.A. has indicated that the egg content of alimentary pastes (egg noodles) can be estimated from the lipid-phosphorus[1] or choline content,[2] and that the accuracy of the method based on lipid-phosphorus content is unaffected by storage for six months.[3] On the other hand Acker, Diemar & Jäger,[4] confirming the work of Hadorn & Jungkunz,[5] have found that macaroni and vermicelli (band noodles) suffer a serious apparent loss of egg content, as measured by lipid phosphorus, during manufacture and subsequent storage at moisture contents too low for the growth of micro-organisms. Acker *et al.* concluded that the apparent loss of egg content is due to enzymic decomposition of the 'lecithin', and further showed that the phospholipid of the dried whole egg and dried egg yolk used decomposed rapidly when the egg powder was reconstituted and stored at 30° in the presence of an inhibitor of microbial growth. Splitting of the phospholipid was measured by determination of the choline content of an ether extract of egg treated with trichloroacetic acid. In a typical experiment with an American spray-dried whole egg approximately half of the ether-soluble choline had disappeared after incubation for 4 hours, and all of it in about 20 hours. A Chinese dried-egg yolk which had probably been heated more strongly during preparation showed a lower enzymic activity and required 72 hours for complete loss of the ether-soluble choline, but an American spray-dried yolk again showed the high activity. No increase in acidity of the ether extract could be detected. It was concluded that dried egg contains an enzyme capable of splitting lecithin with liberation of choline but not of fatty acids, and the resemblance of its pH and temperature optima (6·0–6·4; 25°) to those of the phospholipase D of carrots was pointed out.

Enzymes capable of rapidly splitting lecithin into choline and a phosphatidic acid have recently been reported in carrot,[6, 7] cabbage,[8] rubber latex[9] and spinach chloroplasts,[10] but

* In this paper the enzyme that hydrolyses lecithin to phosphorylcholine and a diglyceride is referred to as phospholipase C, and that which produces choline and a phosphatidic acid as phospholipase D. Some authors, e.g. Hanahan & Vercamer,[16] reverse these definitions.

the review by Lineweaver *et al.*[11] does not mention the presence of such an enzyme in fresh egg, nor does its presence seem to have been reported in dried egg.[12] On the other hand, various micro-organisms have been shown to possess apparent phospholipase-D activity, liberating choline from egg yolk[13] and from isolated phospholipids,[14] although recent work suggests that the consecutive action of a series of enzymes starting with phospholipase A, and therefore entailing simultaneous liberation of fatty acids, may be involved.[14] Other organisms such as *Bacillus cereus*[13] and the *Clostridia*[15, 16] possess phospholipase C, by which lecithin is split into phosphorylcholine and a diglyceride.

In the experiments reported below we have been unable to observe more than a slight loss of choline from the phospholipids of fresh egg yolk or of spray-dried whole egg of good quality when incubated for 30–46 hours at 25° and pH 6·15 under aseptic conditions (fresh yolk) or in the presence of an antimicrobial agent (dried whole egg). It seems likely, therefore, that the loss of ether-soluble choline observed by Acker *et al.*[4] during the incubation of reconstituted dried egg was due to decomposition of lecithin by microbial enzymes, rather than to any lecithinase activity of the fresh egg. Lecithinase-D action alone could not, in any case, account for their observation that the titratable acidity of the ether extract had not increased, even when all its choline had been lost: further enzymic decomposition of the phosphatidic acid to diglyceride and phosphoric acid (water-soluble) would have been necessary. Alternatively, and more probably, splitting by microbial phospholipase C to diglyceride and phosphorylcholine (water-soluble) would account for their results. It has not been possible to check this hypothesis, since we have not observed the splitting.

As our experiments have also indicated that microbial growth is unlikely to have been suppressed very effectively under the conditions of incubation described by Acker *et al.*, it is possible that some contribution to their observed decomposition of the phospholipid may have resulted from the further growth of micro-organisms during incubation of the reconstituted dried egg.

In view of recent observations that lecithinases are powerfully activated by ether,[10, 17] we also incubated fresh yolk and reconstituted dried whole egg in the presence of ether, without, however, producing any greater liberation of choline.

Experimental

Incubation

Fresh egg yolk.—Eggs not more than a few hours old were opened aseptically and each yolk was diluted with 120 ml. of sterile water. Aliquots (10 ml.) of the diluted yolk were treated as described below for extraction of the phospholipid both before and after storage at 25°. The pH of the diluted yolk was measured and bacteriological counts of organisms viable at 20° and at 37° were made in samples taken before and after incubation. In some experiments 1 ml. of peroxide-free ether was mixed with each 10 ml. of diluted yolk before incubation.

Dried whole egg.—Spray-dried whole-egg powder (12–14 g.) was reconstituted with distilled water (120 ml.) and adjusted to pH 6·15 with hydrochloric acid, and 10-ml. aliquots were treated with (*a*) 1 drop of chloroform plus 1 drop of toluene, as described by Acker *et al.*, or 3 drops of chloroform plus 3 drops of toluene, (*b*) 0·5 ml. or 1·0 ml. of 1% (i.e. 0·05% or 0·1%) Merthiolate (thiomersalate) and (*c*) 1 ml. of ether. Bacteriological counts were made as described above, before and after incubation.

Extraction of the phospholipid

In a first series of experiments the phospholipid was isolated from the 10-ml. aliquots of diluted egg in the way described by Acker *et al.*, i.e. by adjustment of the pH to about 3 with trichloroacetic acid, followed by extraction with ether. Unlike Acker *et al.*, we were unable to recover virtually all of the choline from egg yolk by this method (Table I), and recoveries from whole-egg powder, particularly after incubation, were still lower.

In a second series of experiments the 10-ml. aliquot of diluted fresh yolk or reconstituted dried whole egg was extracted by shaking with 100 ml. of chloroform–methanol (1 : 1, v/v)

Table I

Recovery of phospholipid phosphorus and choline from fresh egg yolk and from reconstituted spray-dried whole egg before and after incubation at 25°

Expt. No.	Anti-microbial agent*	pH	Incubation, h. at 25°	Egg solids taken, mg.	Lipid extracted by	Phospholipid recovered		
						P, mg.	Choline, mg.	Choline/P ratio
				Fresh egg yolk				
1	—	6·13	0	630	ether	2·50	7·86	0·81
,,	—	,,	0	,,	,,	2·65	8·25	0·80
,,	—	,,	31	,,	,,	2·19	6·42	0·75
,,	—	,,	31	,,	,,	2·05	6·15	0·77
2	—	6·15	0	—	ether	2·12	6·63	0·80
,,	—	,,	0	—	,,	2·00	6·31	0·82
,,	—	,,	46	—	,,	2·01	5·82	0·75
,,	—	,,	46	—	,,	2·14	6·06	0·73
3	—	6·15	0	645	chloroform–methanol	5·12	16·91	0·85
,,	—	,,	0	,,	,,	5·06	16·50	0·84
,,	—	,,	30	,,	,,	4·99	15·00	0·77
,,	—	,,	30	,,	,,	5·03	15·83	0·81
,,	E	,,	30	,,	,,	5·06	15·28	0·77
,,	E	,,	30	,,	,,	5·32	15·94	0·77
				Spray-dried whole egg				
4	—	6·15	0	1080	chloroform–methanol	5·62	17·6	0·79
,,	—	,,	0	,,	,,	5·35	17·3	0·82
,,	3CT	,,	41	,,	,,	5·15	14·3	0·72
,,	3CT	,,	41	,,	,,	5·22	15·4	0·74
5	—	6·15	0	980	chloroform–methanol	5·00	15·8	0·81
,,	—	,,	0	,,	,,	5·03	16·4	0·84
,,	M	,,	45	,,	,,	4·51	13·4	0·76
,,	M	,,	45	,,	,,	4·68	13·7	0·75
,,	E	,,	45	,,	,,	4·65	15·6	0·84
,,	E	,,	45	,,	,,	4·36	13·7	0·80
,,	MM	,,	30	,,	,,	4·71	14·31	0·78
,,	MM	,,	30	,,	,,	4·64	13·82	0·76

* E represents 1 ml. ether/10 ml. egg suspension
3CT represents 3 drops of chloroform and 3 drops of toluene/10 ml. egg suspension
M represents 0·05%, MM 0·1% merthiolate present

followed by the addition of 20 ml. of water (to form an aqueous layer for removal of any water-soluble choline) and further shaking. The residue was re-extracted with chloroform, the combined extracts were dried over sodium sulphate and the solvent was removed. Greatly improved recoveries of the phospholipids of both fresh and incubated egg were obtained by this method (Table I).

Examination of the phospholipid

Total phosphorus.—For determination of the total phosphorus the solvent was removed from an aliquot of a chloroform solution of the phospholipid, the residue was digested with perchloric acid and phosphorus determined by the method of Allen.[18]

Choline.—The choline content of the phospholipid was determined on an aliquot of the same chloroform solution. After removal of the solvent the phospholipid was hydrolysed with N-sodium hydroxide for 1 hour at 100°, acidified, chilled and filtered to remove the fatty acids. Choline was then determined in the filtrate by the colorimetric periodide method of Appleton *et al.*[19]

Acidity.—In some cases the free acidity of the phospholipid extracted before and after incubation of the diluted egg suspension was measured by titration with sodium hydroxide in hot 95% ethanol, with phenolphthalein as indicator.

Results and discussion

No difficulty was encountered in preparing dilutions of fresh yolk under aseptic conditions, and the samples were still sterile after incubation for 30–46 hours at 25°.

The bacterial counts given in Table II show that the addition of 1 drop of chloroform plus 1 drop of toluene, as used by Acker *et al.*, was not sufficient to prevent considerable microbial growth during the incubation of reconstituted dried egg. Three times these quantities of chloroform plus toluene, 1 ml. of ether and 0·05% Merthiolate were somewhat better, and 0·1% Merthiolate was completely effective.

Table II

Bacterial growth during the incubation of reconstituted spray-dried whole egg in the presence of antimicrobial agents*

Expt. No.	Incubation, h. at 25°	Anti-microbial agent‡	Bacterial count/ml. (20°) Initial	Bacterial count/ml. (20°) Final	Bacterial count/ml. (37°) Initial	Bacterial count/ml. (37°) Final
6†	30	1CT	2×10^4	$> 10^8$	5×10^4	$> 10^8$
4	41	3CT	3×10^3	$> 10^7$	3×10^2	5×10^5
5	—	—	2×10^4	—	2×10^2	—
,,	45	E	5×10^3	2×10^5	1×10^2	2×10^5
,,	45	M	2×10^2	$> 10^7$	$< 10^2$	5×10^4
,,	30	MM	0	0	0	0

* In all experiments with fresh egg yolk the bacterial count was zero both before and after incubation.
† The spray-dried whole egg used in this experiment had not been treated with glucose oxidase before drying.
‡ CT represents 1 or 3 drops of chloroform and 1 or 3 drops of toluene/10 ml. of egg suspension. E, M and MM have the same significance as in Table I.

Both with fresh egg yolk and with reconstituted whole-egg powders the total phospholipid recoverable (measured as total lipid P) fell only slightly or not at all as a result of incubation for as long as 31–46 hours, and the choline/P ratio showed only a slight fall (Table I). In contrast, Acker *et al.*, who apparently did not measure the total quantities of phospholipid recovered, found a rapid reduction in the amount of ether-soluble choline recoverable after incubation—to half of the initial value after about 4 hours and to zero after about 20 hours. No increase in acidity of the ether extract occurred either in the experiments of Acker *et al.* or in the present series, such as would have been expected from the production of free fatty acids by the action of phospholipase A, phospholipase B or lipase, or of phosphatidic acids by the action of phospholipase D. Ether, which has been found to activate the phospholipase D of spinach chloroplasts,[10] was without effect either on the fresh egg yolk or on the dried whole-egg system (Table I).

The spray-dried whole-egg powder used in the experiments reported in Table I was supplied by Dr. J. Brooks and had been prepared from pulp from which the glucose had been removed by enzymic oxidation before drying. It had a pH after reconstitution of 7·25, a moisture content of 4·5% and a solubility of 98%. [These analytical data were provided by Dr. Brooks. The pH of spray-dried whole egg after reconstitution is usually[12] about 8·5–8·9. The lower value in the present case is probably due to the conversion of glucose into gluconic acid by enzymic oxidation. This treatment is not likely to have been applied to the powders used by the German workers.] The only pH value quoted by Acker *et al.* was 6·6 for the specimen of reconstituted spray-dried whole egg of which the behaviour on incubation is reported above. This observation, in conjunction with the fact that powders which when reconstituted give a pH of 7 or below are generally observed to possess unsatisfactory palatability scores,[12] suggests that the material used by Acker *et al.* had suffered some microbial decomposition and probably contained pre-formed microbial enzyme which—possibly reinforced by some further microbial growth during incubation—would be sufficient to account for their results. The action of phospholipase C rather than of phospholipase D, however, would appear to be indicated from their observations, and it is known that this enzyme can be produced by various bacteria. There seems no reason for believing that egg itself, whether fresh or dried, contains any considerable amount of active, pre-formed phospholipase.

Acknowledgments

Mr. J. Barlow carried out the bacteriological control work and Mr. L. J. Parr supplied details of technique. This investigation was carried out as part of the programme of the Food Investigation Organization of the Department of Scientific and Industrial Research. One of the authors (R. A. L. W.) is indebted to the D.S.I.R. for a grant.

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Received 23 August, 1954

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THE RELATIONSHIP BETWEEN THE BORON CONTENTS OF SOILS AND SWEDE ROOTS

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By boiling a 1 : 2 suspension of soil in water under reflux for 15 minutes, a quantity of boron was extracted which gave a good index of the amount available to plants. If this 'available' boron fell below 0·7–1·0 p.p.m. of air-dried soil, raan (brown heart) was liable to occur in swedes grown in the area.

Dressings to the soil of up to 30 lb. of borax per acre increased the available boron by substantial amounts. The boron content of the swedes cropped was also raised considerably and the incidence of raan lowered, and no toxic effects of borax treatment were noted. There was no effect on yield of roots and only a little on dry-matter content.

An application of limestone to a heavy soil, bringing the pH up to 8·1, caused only negligible symptoms of raan in a swede crop and did not appear to fix any of the applied boron.

Introduction

Investigations on soil boron during the past twenty years have shown that the total boron content of soils bears no relation to the incidence of boron-deficiency symptoms in crops grown

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on these soils, and attempts have been made to find a method of extraction which will give a measure of the amount of boron available to the plant.

In 1939 Robinson, Whetstone & Byers,[1] by extracting soils with 85% phosphoric acid, obtained figures which were in accordance with crop response, but Berger & Truog[2] maintained that, although acid extraction gave more satisfactory results than the estimation of total boron, the amount obtained by refluxing a 1 : 2 soil/water suspension for five minutes gave a much better correlation. De Turk & Olson[3] also concluded that the water-soluble boron, although not an exact index to the boron available to the plant, was probably more satisfactory than either the acid-soluble or total boron; Haas[4] discovered that the amount of boron extracted from a soil by boiling with water depended to a considerable extent on the ratio of soil to water.

Dermott & Trinder[5] realized that the conditions of extraction would have to be carefully standardized before comparative estimations could be carried out on different soils, and they related the boron obtained by fifteen minutes' refluxing with water to the onset of deficiency symptoms in swedes. The highest amount of 'available' boron which they found, 0·95 p.p.m. of air-dried soil, was in a field periodically flooded by the sea, and they estimated that raan (brown heart) was liable to occur in swedes when the available boron was less than 0·3 p.p.m.

The occurrence of raan in swedes and turnips was fairly extensive in the south-east of Scotland during 1949, which was a moderately dry growing season. While routine investigations were being carried out it became apparent that existing data on soil-boron status were insufficient for advisory purposes in the area. Experiments were carried out to determine the total amount of boron to be expected in healthy swede roots and in those showing the obvious symptoms of boron deficiency. The water-soluble boron content of soils was estimated by the method of Dermott & Trinder in order to confirm its applicability and to ascertain the levels of available boron to be expected in some 'healthy' and deficient soils of different drainage types. At the same time any effects of boron applications on yield, dry-matter content and incidence of raan were noted.

Analytical procedure

The method of Dickinson[6] and Dermott & Trinder[5] for the determination of boron in soil extracts and plant material with alizarin S as colorimetric reagent was found not to be satisfactory. The colour of an aqueous-alcoholic methyl orange solution, which they used as a standard for comparison in a Duboscq-type colorimeter, did not resemble that of alizarin S in concentrated sulphuric acid solution sufficiently well to allow consistent matching. Further, in contrast with the experience of Dickinson, it was found that the colour of the reagent changed and did not merely deepen, so that comparison with a 'blank' was also difficult. Visual comparison with individual standards and estimation with a photoelectric colorimeter were unsatisfactory.

The method was therefore modified by incorporating the procedures of Smith[7] and Berger & Truog.[8]

(*a*) *Soil*

Soil (50 g.), air-dried and passed through a 2-mm. sieve, is added to 100 ml. of hot water, which is then raised to the boiling point as quickly as possible and refluxed for 15 minutes. The mixture is quickly filtered by suction through a Whatman No. 40 paper into a roughly graduated filter tube; 20 ml. of the clear yellow extract is added by pipette to 1 ml. of 10% aqueous potassium carbonate solution in a platinum or silica basin and evaporated to dryness on a steam bath. The residue is ignited in a muffle furnace, the temperature being raised to 600° and maintained there for 15–20 minutes. As soon as the basin is cool the ash is extracted with 10 ml. of 0·36N-sulphuric acid; the mixture is stirred thoroughly, allowed to stand for ten minutes, and then filtered through a Whatman No. 40 paper into a sample tube; 1 ml. of the filtrate is transferred by pipette to a soft-glass comparison tube, which has previously been 'aged' by long immersion in concentrated sulphuric acid, and treated with 9 ml. of A.R. 98% sulphuric acid, the tube being immersed in cold water; 0·5 ml. of a solution of

quinalizarin reagent [0·01 g. in 100 ml. of 9 : 1 (v/v) H_2SO_4] is then added, a polythene stopper is placed in the tube, and the contents are well mixed by gentle swirling. The colour is allowed to develop overnight and then compared with standards covering the range 0–4·0 μg. of boron, also made up in 9 : 1 H_2SO_4. It was found advisable to make up fresh standards every fortnight, although in most cases the colours were stable for much longer. Care must be taken to prevent undue exposure of the sulphuric acid reagents to the atmosphere as the acid concentration is critical.

It has been pointed out by Winsor[9] that filter paper contains an appreciable amount of acid-soluble boron, but several boron estimations carried out as described gave results practically identical with those obtained when solutions were centrifuged instead of filtered.

(*b*) *Plant material*

The material is oven-dried at 80–100°. Sufficient of the dry matter to give up to 40 μg. of boron (1 g. is used for swedes) is well mixed with 3 ml. of freshly prepared lime-water in

Table I

Effect of borax on incidence of raan

Site	Variety	Incidence of raan, %				Boron in roots, p.p.m. of dry matter	
		At harvest		After storage			
		C	B	C	B	C	B
NH	1	0	0	0	0	11	17
	2	0	0	0	0	16	25
	3	20	0	7	0	12	18
	4	13	0	10	0	14	20
S	1	30	23	—	—	15	15
	2	10	3	—	—	17	17
	3	13	7	—	—	13	14
	4	30	23	—	—	14	14
H	1	0	0	2	0	14	17
	2	0	0	—	—	18	19
	3	0	0	—	—	15	15
	4	0	0	2	0	13	15
MT	1	0	0	4	0	14	14
	2	0	0	0	0	17	16
	3	8	2	6	4	13	13
	4	5	0	11	1	12	13
A	2	4	0	—	—	16	14
	3	7	5	—	—	14	12
	5	7	7	—	—	13	16
	6	33	40	—	—	12	13
	7	20	13	—	—	13	16
	8	7	7	—	—	16	17
	9	0	7	—	—	16	14
	10	0	0	—	—	14	16

a silica or platinum basin. The suspension is evaporated to dryness on a steam bath and ignited as for soils. With some materials, such as mangolds, ignition may have to be slightly prolonged. Extraction of the residue and colorimetric estimation of boron are carried out as described above.

Results

The first series of experiments (1950) were designed to give some idea of the boron contents to be found in healthy and boron-deficient swede roots and to ascertain whether any marked difference existed in the susceptibilities of different varieties to raan. After normal manuring of the selected sites, several varieties of swedes were sown. Borax was applied to strips up to 40 drills wide at a rate of 20 lb. per acre, mixed with sand or dry soil as filler.

Similar untreated strips served as controls. Some soil samples were taken before the applications. During the growing season the plants were inspected for any external symptoms of deficiency, but none was noted. The roots in each plot were weighed at harvest and thirty taken at random were examined for symptoms of raan. Core samples of the roots were taken on each plot. In some cases roots were stored in clamps and examined for symptoms of raan several months later.

The sites were:

NH, Nether Horsburgh .. light medium loam with boron, 0·8–1·0 p.p.m.
S, Scoughall .. .. sandy soil with boron, 1·0–1·4 p.p.m.
H, Hawthornside .. light gravelly soil with boron, 1·2–1·7 p.p.m.
MT, Morebattle Tofts .. light loam with boron, 1·9–2·1 p.p.m.
A, Auldhame .. .. clay loam

The varieties were: 1, Angus Purple Top; 2, Coxton Crofter; 3, Victory; 4, Springwood Purple Top; 5, Favorite Purple Top; 6, Record Bronze Top; 7, Conqueror Green Top; 8, Wilhelmsburger; 9, Green Top; 10, White Flesh.

The average results are given in Table I, C referring to control plots and B to plots treated with borax.

The next series of experiments (1951) were laid down in the form of latin squares at four centres, a single variety of swedes being sown at each after normal manuring. Borax treatments were applied before or shortly after singling, as follows: C control, B1, B2 and B3 respectively 10, 20 and 30 lb. of borax per acre. Soils were sampled before borax application and again in the autumn. Plants were examined throughout the growing season for any visible differences between plots. The roots were weighed at harvest, and thirty, selected at random, were split and examined for symptoms of raan. Core samples of the roots were taken from each plot. The average results are set out in Table II.

The sites and varieties were:

M, Morridgehall .. clay loam (Benefactor's Purple Top)
Ch, Choicelee .. .. medium heavy loam (Victory)
NH, Nether Horsburgh .. light medium loam (Victory)
S, Scoughall .. .. sandy loam (Victory)

Table II

Effect of different amounts of borax on roots and soil

Site and treatment		Yield of roots, tons/acre	Dry matter in roots, %	Incidence of raan at harvest, %	Boron, p.p.m. of dry matter		
					Roots	Soil	
						Spring	Autumn
M	C	27·0	11·3	8 (5)*	10	—	—
	B1	26·4	11·5	2 (3)	11	—	—
	B2	26·7	11·8	3 (2)	12	—	—
	B3	25·8	11·4	2 (1)	14	—	—
Ch	C	—	9·7	—	11	1·0	0·6
	B1	—	9·8	—	16	1·0	0·9
	B2	—	10·2	—	16	0·7	1·0
	B3	—	10·2	—	17	1·1	1·3
NH	C	21·5	10·7	7	9	0·8	0·8
	B1	17·2	10·9	1	14	0·8	1·2
	B2	19·9	11·1	1	14	1·1	1·5
	B3	19·0	11·0	0	16	0·8	1·9
S	C	24·2	11·2	3	12	1·3	1·0
	B1	25·2	11·2	3	13	2·0	1·1
	B2	25·3	11·0	3	13	1·8	1·3
	B3	23·8	11·3	2	15	2·5	1·5

* After storage

Discussion

In the two series of experiments no differences between plots were visible during the growing season, and at no time were there any signs of boron toxicity. The borax treatments considerably reduced the incidence of raan and, with few exceptions, increased the amount of boron in the roots.

The boron content of the swede roots grown in the area ranged for the most part between 10 and 20 p.p.m. of dry matter. It must be remembered that boron and calcium are closely related in the plant[10, 11] and normal growth will occur only when a suitable balance is struck between the amounts of the two elements in the plant. No sharp dividing line can therefore be drawn between the boron contents of healthy and deficient roots, but a figure of about 16 p.p.m. seemed to be critical for most varieties and some varieties seemed to be less susceptible than others.

A statistical analysis of the data in Table II showed that treatment with borax had no effect on yield, but the percentage of dry matter in the roots was increased by treatments B1 and B2 at Morridgehall and by treatments B2 and B3 at Choicelee. The boron content of the roots showed a significant increase with borax treatment in all four places ; at Choicelee there was no difference between the three borax treatments, but at the other three centres there was a significant increase with increasing levels of borax, the average increases ranging from 0·9 to 2·0 $\pm$ 0·2 p.p.m. per 10 lb. of borax per acre. The 'available' boron in the soil in autumn also showed a significant linear increase with level of borax applied, the average values for the increase for every 10 lb. of borax per acre being 0·21 $\pm$ 0·067 p.p.m. (Choicelee), 0·37 $\pm$ 0·05 p.p.m. (Nether Horsburgh), 0·18 $\pm$ 0·047 p.p.m. (Scoughall).

Apparently swedes grown on light sandy soils are susceptible to raan as expected, but the disease was also severe on a clay soil at Auldhame in 1950. Boron status can best be assessed by considering available boron in conjunction with soil type. It would appear that 0·7 p.p.m. of boron is sufficient to give sound root crops on medium and heavy soils, whereas on light sandy soils a level of 1·0 p.p.m. or more is required.

No marked increase in the proportion of roots suffering from raan was noticed after storage in clamps during the winter. It is possible, however, that some roots apparently suffering from severe soft rot were in fact in an advanced state of decomposition due to raan.

An attempt was made at one centre to induce raan in swedes, grown on a fairly heavy clay, by application of limestone shortly before sowing. Four plots each received a normal fertilizer dressing ; plots A and D received ground limestone at the rate of 15 cwt. per acre, which raised the pH value from 6·5 in March to 8·1 in November ; plots C and D received a dressing equivalent to 20 lb. of borax per acre.

The only visible differences during growth were on plots which had received limestone, where the braird was noticeably poorer. The soils were sampled five times during the growing season and thirty roots were selected at random from each plot and sectioned for examination for symptoms of raan.

The available soil boron rose towards the middle of the growing season and then declined, the maximum change being in plot D, 1·4 to 1·9 to 1·5 p.p.m. ; the initial values for plots A, B and C were 1·3, and the final values were respectively 1·2, 1·1 and 1·3 p.p.m. The soil boron was therefore barely affected by the dressing of limestone. The only sign of raan, however, was on the plot which received limestone and no borax.

Acknowledgments

The authors are very much indebted to Mr. W. A. Buckpitt, Dr. H. H. Corner, Mr. H. J. Usher, Mr. R. G. White and Dr. S. M. Wylie for their co-operation in the field work and to Mr. R. H. E. Inkson for carrying out a statistical analysis of the results.

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Received 31 August, 1954

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THE COMPONENT FATTY ACIDS AND GLYCERIDES OF COCONUT OILS

By AMY PAULINE DALE and M. L. MEARA

Specimens of coconut oil of Indonesian, Solomon Islands and Ceylonese origin have been found to contain the following fatty acids: caproic 0·2, 0·3, —; caprylic 7·7, 8·1, 7·3; capric 9·7, 8·1, 7·5; lauric 45·0, 46·3, 47·8; myristic 18·0, 17·4, 18·9; palmitic 8·4, 8·6, 7·6; stearic 3·7, 2·0, 2·5; arachidic —, 1·5, 0·4; oleic 5·8, 5·5, 6·3; linoleic 1·5, 2·2, 1·7% (wt.).

These data, taken in conjunction with earlier analytical figures, indicate that the composition of coconut oils produced in widely scattered regions remains practically constant.

The oil consists of a very complex mixture of mixed triglycerides, only two components of which (myristodilaurin and lauromyristopalmitin) occur to the extent of over 10%.

Introduction

Because of its great commercial importance coconut oil has been the subject of numerous investigations. Among these may be mentioned the unsuccessful attempts of Caldwell & Hurtley[1] to isolate individual triglycerides from coconut oil by fractional distillation at very low pressures. By a similar distillation, Bömer[2] separated the constituents of smallest molecular size and further resolved the resulting fractions by a rigorous crystallization technique. As a result Bömer appears to have isolated relatively large amounts of concentrates of caprylo-lauromyristin and of myristodilaurin, together with smaller amounts of concentrates of lauro-dimyristin, palmitodimyristin and stearodipalmitin. No account was taken of the mixed saturated-unsaturated glycerides, these apparently being too soluble for resolution by the crystallization technique employed. Collin & Hilditch[3] attacked the problem from a different angle by determining the component fatty acids of the oil and those of the fully saturated glycerides, after removal, as azelao-glycerides, of the mixed saturated-unsaturated glycerides. They showed that the specimen of coconut oil examined by them comprised 84% of fully saturated glycerides, containing mixed glycerides of all the saturated acids occurring in coconut oil, with myristodilaurin predominating, and 16% of mixed saturated-unsaturated glycerides, containing 12% of mono-oleodisaturated glycerides and 4% of dioleomonosaturated glycerides.

In the present investigation the component fatty acids of three coconut oils, one each from Indonesia, the Solomon Islands and Ceylon, were determined by using an electrically heated and packed fractionating column of much greater efficiency than was available to the earlier workers. Further, an attempt was made, with the crystallization techniques so successfully developed in these Laboratories for the determination of the constitution of oils of a much higher order of unsaturation, to arrive at an accurate estimate of the component glycerides of oil from Indonesian coconuts.

Experimental

Methods

The characteristics of the oils investigated appear in Table I.

Table I

Characteristics of coconut oils

Source	Indonesia	Solomon Islands	Ceylon
Saponification equivalent	214·7	214·8	223·6
Iodine value	9·0	8·1	8·2
Free acidity (as lauric acid, %)	4·1	4·6	0·6
Unsaponifiable matter, %	1·2	1·4	0·7

Since it was found that direct methanolysis of the oil, in the presence of alkali[4] or in the presence of acid,[5] gave variable yields of methyl esters this method was considered unsuitable in the present instance. The component fatty acids were determined by fractionation of the methyl esters derived from the mixed fatty acids of the oils. Loss of the lower fatty acids and esters in aqueous solution was prevented by adequate ether extraction, and also by thorough drying of the ethereal solution of the acids and esters before removal of the solvent. The saponification equivalent and iodine value of each ester fraction were determined, and spectroscopic determinations for the estimation of the unsaturated (C_{18}) components were made on the acids recovered from the appropriate ester fractions of maximum iodine value. Table II includes the component fatty acids of the oils investigated, together with other relevant data for comparative purposes.

The component glycerides were determined by systematic crystallization of the oil from acetone by using the techniques described by Barker & Hilditch,[6] Crossley & Hilditch[7] and Hilditch & Seavell.[8] It may be noted that, in the present case, as in all instances when oils relatively low in unsaturated components are investigated, it is usually impossible to obtain fractions which differ as widely in composition as do those frequently obtained by resolution of highly unsaturated oils. Nevertheless, the coconut oil was resolved into nine fractions of different mean unsaturation, the iodine values ranging from 0·4 to 43·8. Each group will still therefore contain both trisaturated and mixed saturated-unsaturated glycerides, but each group will be simpler in composition than the original oil and therefore more amenable to computation of the probable component glycerides.

Results

(*a*) *Component fatty acids*

It is seen from Table II that the component acids of all the specimens of coconut oil so far examined, with the exception of those studied by Armstrong, Allan & Moore[11] and Nobori,[12] show major divergencies. It seems probable therefore that the former workers have over-estimated the lauric acid content and the latter has over-estimated the same acid at the expense of myristic acid. Further, in two cases out of three we have confirmed the occurrence of caproic and arachidic acids in small amounts in coconut oils.

Table II

Component fatty acids of coconut oils, % (wt.)

	Saturated								Oleic	Linoleic
	C_6	C_8	C_{10}	C_{12}	C_{14}	C_{16}	C_{18}	C_{20}		
Indonesia	0·2	7·7	9·7	45·0	18·0	8·4	3·7	—	5·8	1·5
Solomon Islands	0·3	8·1	8·1	46·3	17·4	8·6	2·0	1·5	5·5	2·2
Ceylon	—	7·3	7·5	47·8	18·9	7·6	2·5	0·4	6·3	1·7
Collin & Hilditch[3]	—	7·9	7·2	48·0	17·5	9·0	2·1	—	5·7	2·6
Lepowsky *et al.*[9]	0·6	9·0	6·8	46·4	18·0	9·0	1·0	—	7·6	1·6
Longenecker[10]	0·8	5·4	8·4	45·4	18·0	10·5	2·3	0·4	8·8	Trace
Armstrong, Allan & Moore[11]	—	9·5	4·5	51·0	18·5	7·5	3·0	—	5·0	1·0
Nobori[12]	—	8·7	8·1	51·3	13·1	7·5	2·0	1·5	5·5	2·3

It is possible that some slight variation in the constitution of coconut oil occurs with the geographical location at which the fruit is produced, but from the present investigation this appears to be only of a minor order bordering on the limits of experimental error. This may well be because the natural habitat of the coconut palm is confined to tropical coastal regions.

A factor that causes variation in the composition of the oil seed is the rate of ripening of the seed. Thus oils from the same varieties of sunflower seeds grown in different parts of the world have been shown by Barker & Hilditch[13] to differ appreciably in constitution. There is now good evidence for believing that separate processes are operating for the production of saturated and unsaturated acids in the ripening seeds, but although both the amount and distribution of the saturated acids remain more or less constant, considerable variation in the distribution of the unsaturated (C_{18}) acids can occur. The unsaturated-acid content of coconut oil, however, is so low (of the order of 10%) that any moderate variation, even of the order of that in sunflower-seed oils, would probably be masked by experimental error. It follows that coconut oil from any source would be expected to be practically constant in constitution.

(b) Component glycerides

The weights and characteristics of the nine glyceride fractions into which the oil was resolved are given in Table III. This Table further includes the molar percentages of the component fatty acids of each group of glycerides, the increments of the categories of glycerides present in each group, deduced from the component fatty acids expressed in terms of moles, and the molar contribution of the fraction to the whole oil, and finally the increments of the possible component glycerides.

Discussion

It is seen that, even after the rigorous crystallization to which the oil was subjected, the most insoluble (A) fraction still contained a certain amount of mixed saturated-unsaturated triglycerides. This is in keeping with the findings of Meara & Patel,[14] who likewise failed to remove completely the mixed saturated-unsaturated glycerides from dika fat by a similar crystallization procedure. This phenomenon is undoubtedly due to the operation of a mutual solubility effect. The tri-acid glycerides are considered to be the components primarily responsible for this effect, since not only do they occur in quantity in dika fat, but also in cacao butter,[15] which contains 57% of oleopalmitostearin and from which fully saturated glycerides could not be obtained by crystallization. No difficulty was encountered in the isolation of the fully saturated glycerides from palm oil,[16] which contained only 7% of the above-mentioned tri-acid glyceride.

A number of observations may, however, be made. Apart from caproic acid, which occurs only in traces, the remaining component acids are present in all fractions, with the following exceptions: caprylic acid, absent from fractions A and B, stearic acid from H, and linoleic acid from A, B and D. Despite the rigorous crystallization the fractions are by no means simple in composition, at least six different acids being present in each group of glycerides. Nevertheless, each fraction contains a simpler mixture of glycerides than the original fat. In addition to the concentration of glycerides containing unsaturated acids in fractions H and I there is a tendency for glycerides containing particular acid groups to be concentrated in certain glyceride groups. Thus although caprylic acid is absent from fractions A and B it is concentrated in fractions E, F and G. There is a marked tendency for the content of capric acid to increase with increase in the solubility of the fraction. Lauric acid, although present in all fractions, occurs in fractions A–G in amounts indicating the presence of some dilauroglycerides, but only in fractions B and D does it occur to the extent of over 50%. Likewise myristic, palmitic and stearic acids (with the above-mentioned exception) are present in all fractions, and their amounts tend to decrease with increase in solubility of the fraction. On the other hand, the amounts of oleic and linoleic acids increase steadily as the amounts of the higher saturated acids fall.

Although we have been unable to confirm the presence of diunsaturated glycerides in coconut oil the presence of small amounts of these components cannot be completely precluded,

since the mutual solubility effect might well have caused the separation of fully saturated glycerides from fractions H and I to be somewhat more incomplete than appears in Table III. Nevertheless, it may be deduced that no marked amounts of di- or of tri-unsaturated glycerides can occur in these fractions, indicating the possible presence of only minimal quantities of this category of glycerides.

Table III

Component acids and glycerides of fractions obtained by crystallization of coconut oil

	A	B	C	D	E	F	G	H	I	Total
Weight, g.	16·86	22·75	57·19	31·54	27·04	47·09	29·42	11·82	13·52	257·24
Iodine value (found)	0·4	0·5	1·0	2·6	5·7	7·2	21·7	33·5	43·8	9·0
Saponification equiv. (calc.)	235·7	224·8	221·9	220·1	215·6	213·9	219·1	220·6	230·4	218·6
Unsaponifiable, %	—	—	—	0·1	0·4	0·6	0·5	1·8	1·6	
Glycerides, % (wt.)	6·5	8·8	22·3	12·3	10·5	18·3	11·4	4·4	5·3	100·0
,, % (mol.)	6·1	8·7	22·1	12·3	10·8	18·9	11·5	4·6	5·0	100·0
Component acid groups (% mol.)										
Caproic	—	—	—	—	—	0·3	—	10·3	—	
Caprylic	—	—	4·8	1·8	12·6	16·6	19·5	8·5	13·3	
Capric	5·0	8·1	14·9	12·8	13·1	10·7	8·7	15·7	20·2	
Lauric	39·8	56·7	46·6	58·4	40·7	46·3	39·1	29·8	20·7	
Myristic	30·9	22·6	20·3	16·5	14·3	13·0	13·4	13·1	7·1	
Palmitic	18·3	8·9	0·7	4·9	12·6	6·8	3·2	0·3	7·3	
Stearic	7·0	4·3	3·9	4·8	4·2	1·0	1·0	—	5·0	
Oleic	0·5	0·6	0·7	2·1	3·0	5·0	14·1	17·2	21·5	
Linoleic	—	—	0·1	—	0·7	0·4	1·3	5·1	6·1	
Component glyceride categories										
Trisaturated	6·0	8·6	21·6	11·5	9·6	15·9	6·2	1·5	0·9	81·8
Disaturated-mono-unsaturated	0·1	0·2	0·5	0·8	1·2	3·0	5·3	3·1	4·1	18·2
No lauro	—	—	—	—	—	—	—	0·5	1·8	2·3
Monolauro	4·9	2·6	13·1	3·1	8·1	11·5	9·5	4·1	3·2	60·1
Dilauro	1·2	6·1	9·0	9·2	2·7	7·4	2·0	—	—	37·6
Possible component glycerides										
(*a*) Trisaturated (81·8%)										
Caprylodilaurin	—	—	0·9	—	0·7	2·7	0·7	—	—	5·0
Caprodilaurin	—	1·1	2·7	2·9	0·7	1·9	0·3	—	—	9·6
Myristodilaurin	0·7	3·5	3·6	4·3	0·7	1·9	0·5	—	—	15·2
Palmitodilaurin	0·5	1·5	1·8	2·0	0·7	0·9	—	—	—	7·4
Caprylocaprolaurin	—	—	0·6	0·2	0·9	1·7	1·2	0·8	0·6	6·0
Caprylolauromyristin	—	—	1·1	0·2	0·9	2·9	2·0	0·4	—	7·6
Caprylolauro' palmitin '	—	—	0·6	0·2	1·2	1·0	0·5	—	—	3·5
Caprolauromyristin	0·7	0·7	4·5	0·7	1·0	1·1	0·4	0·4	0·3	9·8
Caprolauro' palmitin '	0·1	0·1	2·0	0·5	1·0	0·9	0·2	—	—	4·8
Lauromyristo' palmitin '	3·9	1·5	3·8	0·5	1·8	0·9	0·3	—	—	12·7
Capromyristo' palmitin '	0·1	0·1	—	—	—	—	—	—	—	0·2
(*b*) Disaturated-mono-unsaturated (18·2%)										
' Oleo 'dilaurin	—	—	—	—	—	—	0·5	—	—	0·5
' Oleo 'caprylolaurin	—	—	—	—	0·3	1·2	2·3	1·3	0·4	5·5
' Oleo 'caprolaurin	—	—	0·2	0·4	0·3	0·6	0·8	0·8	0·8	3·9
' Oleo 'lauromyristin	0·1	0·2	0·2	0·4	0·3	0·6	1·3	0·5	0·4	4·0
' Oleo 'lauro' palmitin '	—	—	0·1	—	0·3	0·6	0·4	Trace	0·6	2·0
' Oleo 'caprylocaprin	—	—	—	—	—	—	—	—	0·5	0·5
' Oleo 'caprylomyristin	—	—	—	—	—	—	—	0·2	—	0·2
' Oleo 'caprylo' palmitin '	—	—	—	—	—	—	—	—	0·5	0·5
' Oleo 'capromyristin	—	—	—	—	—	—	—	0·2	0·4	0·6
' Oleo 'capro' palmitin '	—	—	—	—	—	—	—	—	0·5	0·5

' Palmito ' = palmito + stearo
' Oleo ' = oleo + linoleo

Of the 21 possible component glycerides recorded in Table III only four can be considered as major component glycerides, i.e. occurring to the extent of about 10% or more, and of the remainder seven are present in amounts of less than 1%. Myristodilaurin is undoubtedly the most abundant glyceride, occurring to an extent of approximately 15%; lauromyristopalmitin, caprolauromyristin and caprodilaurin are present in amounts of 13, 10

and 10% respectively, together with smaller quantities of caprylocaprolaurin, caprylolauromyristin and palmitodilaurin. It is noteworthy that Collin & Hilditch,[3] by removal of the mixed saturated-unsaturated glycerides by an oxidation procedure, arrived at a value of 84% for the fully saturated glyceride content of coconut oil, and a value of 82% was obtained in the present investigation.

This investigation has also made evident the impracticability of isolating by fractional crystallization pure specimens of individual triglycerides from coconut oil, either in quantity or in small amounts. For the fractions isolated by Bömer, saponification equivalents and melting points were used as criteria for purity. The saponification equivalent is a function merely of the mean molecular weight of the component acids. Similarly, it is now known that the determination of melting point alone is not sufficient to characterize a triglyceride. It is essential that the transition points of the polymorphic modifications should also be determined, together with the corresponding *X*-ray long spacings, since it is known that under suitable conditions mixtures of glycerides can form well-developed mixed crystals which are practically as stable as those of the components. The melting point of such mixed crystals may, under suitable conditions, lie very near to those of the components, and lead to erroneous deduction ; this probably occurred with the compounds isolated by Bömer.

Acknowledgments

The authors thank Professor T. P. Hilditch for his interest in this work, and the Colonial Products Advisory Bureau for a grant to one of them (A. P. D.) and for authority to publish these results.

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Received 8 July ,1954

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THE COMPONENT FATTY ACIDS AND GLYCERIDES OF PALM-KERNEL OIL

By AMY PAULINE DALE and M. L. MEARA

The component fatty acids of a specimen of palm-kernel oil [with characteristics : saponification equivalent 230·5, iodine value 16·7, free acidity (as lauric acid, per cent.) 8·1, unsaponifiable matter 1·6%] were found to be : caprylic 2·4, capric 3·7, lauric 45·2, myristic 18·6, palmitic 8·5, stearic 2·5, arachidic 1·9, oleic 15·1, linoleic 2·1% (wt.).

The oil is a complex mixture of mixed triglycerides; the major components are myristodilaurin 27·2, caprolauro-olein 12·2, lauromyristo-olein 10·6%. No other component occurs in an amount greater than 10%.

Introduction

Palm-kernel oil, together with coconut oil, constitute the two most important seed fats of the *Palmae*. Since these oils resemble one another in containing only a relatively low percentage of unsaturated acids, together with a relatively high proportion of saturated acids of molecular weight lower than is found in the seed fats of most botanical families, it is not surprising that the same general methods have been adopted in their investigation.

Oudemans[1] in 1876 appears to have made the first comprehensive investigation of palm-kernel oil. At that time, when fats were considered to be mixtures of simple triglycerides, the following composition was reported: tricaprylin, tricaprin and trilaurin 40·4, trimyristin, tripalmitin and tristearin 33·3, and triolein 26·6%. These values, being in fact a measure of the component fatty acids of the oil, do not agree with those obtained by modern methods. Not only is the distribution of saturated acids at variance, but the content of 'triolein' would not in any case fit in with the now known mean unsaturation of the oil. More recent determinations of the component fatty acids of palm-kernel oil have been made by Armstrong *et al.*,[2] Collin & Hilditch[3] and Carsten *et al.*[4] The values obtained by these workers appear in Table I, together with those obtained in the present investigation.

An elaborate and exhaustive crystallization of a specimen of palm-kernel oil was performed by Bömer & Schneider,[5] who were primarily interested in the isolation of individual triglycerides. These workers considered that palm-kernel oil consisted of a large amount of caprylomyristo-olein, considerable amounts of myristodilaurin and small amounts of palmitodimyristin and myristodipalmitin. Collin & Hilditch,[3] by determining the component fatty acids of the oil, and the amount and component fatty acids of the fully saturated glycerides,

Table I

Component fatty acids of palm-kernel oil, % (wt.)

	Saturated						Oleic	Linoleic
	C_8	C_{10}	C_{12}	C_{14}	C_{16}	C_{18}	C_{20}		
Armstrong *et al.*[2]	3·0	3·0	52·0	15·0	7·5	2·5	—	16·0	1·0
Collin & Hilditch[3]	2·7	7·0	46·9	14·1	8·8	1·3	—	18·5	0·7
Carsten *et al.*[4]	4·3	4·8	51·3	16·5	7·6	1·7	0·6	11·9	1·3
,, ,, ,,	3·9	6·3	51·2	17·5	6·5	2·0	0·5	10·9	1·2
Present investigation	2·4	3·7	45·2	18·6	8·5	2·5	1·9	15·1	2·1

deduced that palm-kernel oil comprised 63% of fully saturated glycerides and 37% of mixed saturated-unsaturated glycerides, of which 26% were mono-oleoglycerides and 11% were dioleoglycerides. All the saturated acids present in the oil occurred in both the fully saturated and mixed saturated-unsaturated portions, and there was no indication of the presence of any simple triglycerides. The present investigation, like that of coconut oil (preceding paper), constitutes an attempt to obtain a more accurate determination of the component fatty acids and glycerides of palm-kernel oil than has hitherto been possible.

Experimental

Methods

The characteristics of the oil investigated were: saponification equivalent 230·5, iodine value 16·7, free acidity (as lauric acid, per cent.) 8·1, unsaponifiable matter 1·6%. The component fatty acids were determined as for coconut oil.

Neutralized oil was crystallized from acetone at temperatures ranging from $-60°$ to $+20°$ until it was resolved into ten fractions of iodine values ranging from 0·4 to 46·5. The component fatty acids of each fraction were determined, and the component glycerides computed from the results.

Results

The component fatty acids of the palm-kernel oil under investigation, together with values obtained by earlier workers, are given in Table I.

Table II

Component acids and glycerides of fractions obtained by crystallization of palm-kernel oil

	A	B	C	D	E	F	G	H	I	J	Total
Weight, g.	47·6	49·9	52·0	42·2	46·4	55·3	47·8	32·8	44·0	46·3	464·3
Iodine value (found)	0·4	1·3	1·6	4·4	9·0	18·5	24·6	26·4	38·1	46·5	16·5
Sapon. equiv. (calc.)	231·1	223·2	222·0	223·6	226·4	227·0	234·9	241·4	242·9	250·4	231·4
Unsaponifiable, %	0·2	0·4	0·5	0·3	1·1	0·1	0·3	1·0	0·4	0·8	
Glycerides, % (wt.)	10·2	10·7	11·2	9·1	10·0	11·9	10·3	7·1	9·5	10·0	100·0
,, % (mol.)	10·3	11·2	11·7	9·4	10·3	12·1	10·0	6·8	9·0	9·2	100·0
Component acid groups, % (mol.)											
Caprylic	—	—	—	—	2·1	7·0	8·6	4·8	10·5	3·9	
Capric	1·1	3·7	6·3	10·1	7·6	12·1	7·4	7·2	6·2	2·5	
Lauric	49·8	65·6	68·8	60·2	60·3	43·2	40·5	39·0	34·7	33·0	
Myristic	32·8	24·4	17·9	17·4	14·5	15·5	8·7	13·4	5·0	19·3	
Palmitic	12·9	5·3	4·1	7·8	8·1	4·4	11·5	7·1	3·7	3·5	
Stearic	3·0	—	1·7	1·1	0·8	2·9	2·7	2·6	9·1	2·0	
Oleic	0·4	1·0	1·2	3·2	5·8	14·2	18·6	23·1	26·2	29·6	
Linoleic	—	—	Trace	0·2	0·8	0·8	2·0	2·8	4·6	6·2	
Component glyceride categories											
Trisaturated	10·1	10·8	11·3	8·4	8·3	6·7	3·8	1·5	0·6	—	61·5
Disaturated-mono-unsaturated	0·2	0·4	0·4	1·0	2·0	5·4	6·2	5·3	8·4	8·0	37·3
Diunsaturated-monosaturated	—	—	—	—	—	—	—	—	—	1·2	1·2
Monolauro-di-others	5·2	0·4	—	1·8	1·9	8·6	7·9	5·6	8·7	8·9	49·0
Dilauro-mono-others	5·1	10·8	10·9	7·6	8·4	3·5	2·1	1·2	0·3	0·3	50·2
Trilaurin	—	—	0·8	—	—	—	—	—	—	—	0·8
Possible component glycerides											
(*a*) Trisaturated (61·6%)											
Trilaurin	—	—	0·8	—	—	—	—	—	—	—	0·8
' Capro 'dilaurin	0·2	1·1	2·2	1·9	2·0	1·3	0·5	0·3	0·1	—	9·6
Myristodilaurin	5·0	7·7	6·3	3·1	3·4	1·0	0·3	0·3	—	—	27·1
' Palmito 'dilaurin	—	1·6	2·0	1·6	1·8	0·5	0·5	0·2	0·2	—	8·4
' Capro 'lauromyristin	0·1	0·2	—	0·9	0·4	2·5	0·5	0·7	0·1	—	5·4
' Capro 'lauro' palmitin '	0·1	—	—	—	0·3	0·7	2·0	—	0·2	—	3·3
Lauromyristo' palmitin '	4·8	0·2	—	0·9	0·3	0·7	—	—	0·1	—	7·0
(*b*) Disaturated-mono-unsaturated (37·2%)											
' Oleo 'dilaurin	—	0·4	0·4	1·0	1·1	0·9	0·8	0·5	0·1	0·3	5·5
' Oleo '' capro 'laurin	—	—	—	—	0·4	2·5	1·8	1·6	4·0	1·8	12·1
' Oleo 'lauromyristin	0·1	—	—	—	0·3	1·3	1·8	1·6	1·2	4·3	10·6
' Oleo 'lauro' palmitin '	0·0	—	—	—	0·3	0·7	1·8	1·6	3·0	1·6	9·0
(*c*) Monosaturated-diunsaturated (1·2%)											
Laurodi' olein '	—	—	—	—	—	—	—	—	—	0·8	0·8
Myristodiolein	—	—	—	—	—	—	—	—	—	0·4	0·4

' Capro ' = caprylo + capro
' Palmito ' = palmito + stearo
' Oleo ' = oleo + linoleo

In Table II appear the weights and characteristics of the fractions resolved by crystallization, together with the molar percentage of component fatty acids of each group of glycerides, the increments of these fatty acids with respect to the whole oil, the increments of the categories of glycerides present, and finally the increments of the possible component glycerides.

Discussion

It is seen from Table I that there appears to be a somewhat greater variation in the proportions of the component fatty acids than obtains with coconut oil, this being most marked in the contents of myristic and oleic acids. Thus although the present specimen contains the lowest recorded value for the lauric acid content, this value does not fall far short of that recorded by Collin & Hilditch,[3] but is significantly lower than that recorded by Carsten *et al.*,[4] who also used a fractionating column of high efficiency. On the other hand, although the oleic acid content also is somewhat lower than that reported by Collin & Hilditch,[3] it is possible that these workers may have under-estimated the linoleic acid content, which would result in a somewhat higher value for oleic acid. This latter situation does not arise with the

specimen examined by Carsten *et al.*,[4] in which the oleic acid content was abnormally low. It appears, therefore, that palm-kernel oils can vary in constitution to a greater or less extent according to one or more of the factors geographical location, climate and variety.

Component glycerides

It is seen that each glyceride group obtained by resolution of the neutral oil represents about 10% of the whole oil. The crystallization procedure, as in the resolution of coconut oil (see preceding paper) and of dika fat,[6] did not result in the complete segregation of fully saturated from mixed saturated-unsaturated glycerides in any one fraction, though, naturally, the amount of the latter category is lowest in the fraction of lowest solubility, increasing more or less uniformly with increase in solubility of the fraction.

Table II reveals that, with the following exceptions, all component acids are present in each glyceride group: caprylic, absent from A–D; stearic, absent from B; and linoleic, absent from A and B. The Table nevertheless shows that individual acids are concentrated in particular glyceride groups. Thus B is the fraction of simplest constitution (lauric and myristic constitute 90% of the total acids present) comprising myristodilaurin in high concentration together with smaller amounts of palmitodilaurin and caprodilaurin. Both lauric and myristic acids are major components in each glyceride group; the lauric acid content rises to a maximum in fraction C and then decreases uniformly, whereas the myristic acid content decreases in the earlier fractions and then becomes somewhat variable. The content of palmitic and stearic acids remains somewhat variable throughout the whole glyceride range. Although there is some tendency for the caprylic acid content to increase with increase in solubility of the fraction the capric acid content rises to a maximum and then falls off. The unsaturated acids increase more or less regularly with increase in solubility of the fraction.

Myristodilaurin is the chief component glyceride in fraction B as well as in fractions C, D and E, but in these fractions it is accompanied by relatively greater amounts of caprodilaurin and palmitodilaurin than in fraction A where it is accompanied by an approximately equal amount of lauromyristopalmitin. Fractions F, G, H and I are seen to contain increasing amounts of mono-oleoglycerides, together with a complex mixture of trisaturated glycerides in minor amounts. Finally, fraction J contains no fully saturated glycerides, and consists entirely of mono- and di-unsaturated glycerides.

Because of the complex nature of the fractions obtained it is clear that the order of accuracy attained for the determination of the component glycerides, as with coconut oil, will in no way approach that which can be obtained for simpler fats. Nevertheless, the final values obtained are believed to lie within a few units per cent. of the true values. That this may be so is indicated by the finding of 61·5% of fully saturated glycerides in the oil as compared with 63% recorded by Collin & Hilditch,[3] determined by an oxidation procedure. We have been unable, however, to confirm the occurrence of diunsaturated glycerides to the extent reported by these workers (12·3%), the crystallization data indicating only minimal amounts of this category of glycerides, the bulk of the mixed saturated-unsaturated glycerides occurring as mono-unsaturated glycerides.

Palm-kernel oil, like coconut oil, is seen to consist of a complex mixture of mixed glycerides, only three components of which, namely myristodilaurin, caprolauro-olein and lauromyristo-olein, occur in an amount greater than 10%. Approximately half of the oil comprises dilauro-glycerides, about half of this category, i.e. one-quarter of the whole oil, consisting of myristo-dilaurin which is by far the most abundant glyceride in the oil.

Acknowledgments

The authors thank Professor T. P. Hilditch for his interest in this investigation, and the Colonial Products Advisory Bureau for a grant to one of them (A. P. D.) and for permission to publish these results.

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Received 8 July, 1954

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STUDIES ON EGG SHELLS. VI.*—The Distribution of Pores in Egg Shells

By C. TYLER

The distribution of pores in egg shells has been studied by using a counting technique described in an earlier paper. The distribution is very different from the Poisson form, and different, but less so, from the negative binomial form. A new distribution, based on a modification of the Poisson form, has been developed, and this appears to fit the data quite well. The distribution is such as to give an arrangement of pores lying somewhere between randomness and complete uniformity, and a possible reason for this is discussed.

In a previous paper[1] a method was described for marking and counting pores in hen-egg shells. Shells were boiled in 2·5% sodium hydroxide solution to remove the membrane, then, after washing, pieces were dipped in concentrated nitric acid for 25 seconds, washed and dried. This process enlarged the pore holes and made them easily visible under the microscope. A microscope set to view 1 sq. mm. of shell was then used to inspect one hundred randomly taken pieces of shell and the number of pores in each square millimetre of area was recorded. Thus the mean pore count per unit area was found, and a frequency distribution of pores per square millimetre was also obtained. In the same paper two, more extensive, counts, namely, one of 320 and one of 640 readings, were tested against the Poisson distribution and found to be significantly different from it. It is the purpose of this paper to consider data from a great number of shells and to ascertain whether they fit a Poisson or some other distribution.

Experimental

Material

The data were derived from hen-, pheasant-, guillemot- and razorbill-egg shells. Because of differences in thickness of shell from the different species it was necessary to use different times of immersion in nitric acid, but in every case preliminary tests were made to ensure the use of a time that gave a maximum count. It was realized that, with the ordinary data, the range of mean pore counts was somewhat limited, and it was therefore extended by artificial means. To obtain high mean counts pheasant-egg shells were used and pieces having high counts were deliberately selected. The count on 100 pieces was then carried out in the normal way to obtain the distribution associated with high mean counts. It was difficult to obtain pieces of shell giving very low counts so a different method was used. Guillemot and razorbill shells have some pores so large that they can be seen under the microscope before treating with nitric acid. Counts were therefore made on such shells to obtain the distribution associated with low mean counts. It would be more satisfactory to obtain counts always under

* Part V: *J. Sci. Fd Agric.*, 1954, **5**, 612

the same conditions but, as yet, egg shells normally giving very low and very high counts have not been found. The results to be considered in detail below give no indication that the more artificial data in any way deviate from the general picture and thus there appears to be little argument against using them.

Treatment of raw data

Data from nearly two hundred shells were available so they were grouped in order to reduce individual variation. The data were grouped according to mean pore count values and then for each group the general mean pore count per square millimetre was calculated, and also the mean frequency per 100 counts for 0, 1, 2, 3, 4, 5 and 6 pores. In this way the data set out in Table I were obtained and these were the values used as a basis for all other calculations. The variance of each set was also estimated. It should be remembered that the grouping completely ignores the different types of egg shell; the only basis is mean pore count. Clearly, however, the extreme means will contain the greater proportion of the so-called artificial values.

Relationship to the Poisson distribution

It was realized that if each set of frequency values corresponding with a particular mean were tested against the appropriate Poisson distribution by means of the χ^2 test, then, not only would the procedure be laborious, but, of far greater importance, some cases might give significant differences from the Poisson distribution; others might not, thus making it difficult to form an overall picture. It was therefore decided, for the preliminary work, to approach the problem rather differently.

A series of calculations were made to obtain the Poisson frequency distributions for different mean values between 0·5 and 2·5 by using the first seven terms of the usual formula:

$$e^{-M} : e^{-M}\frac{M}{1!} : e^{-M}\frac{M^2}{2!} : e^{-M}\frac{M^3}{3!} : e^{-M}\frac{M^4}{4!} : e^{-M}\frac{M^5}{5!} : e^{-M}\frac{M^6}{6!} \ldots$$

or

$$e^{-M}\left[1 : \frac{M}{1!} : \frac{M^2}{2!} : \frac{M^3}{3!} : \frac{M^4}{4!} : \frac{M^5}{5!} : \frac{M^6}{6!} \ldots\right]$$

The frequencies for 0 event in the different distributions were then plotted against the corresponding means and the broken-line curve in Fig. 1*a* was thus obtained. Similar curves relating frequency to mean were then drawn for 1, 2, 3, 4 and 5 events and are shown in the same Figure. Data for counts of six events have been omitted because they are so infrequent. These curves represent a whole range of theoretical Poisson distributions, and can therefore be used to give a visual idea of the comparison of the unknown distributions of the type under consideration with them.

In Fig. 1*a* the points relating frequencies of 0 pore/sq. mm. to the mean number of pores per square millimetre, i.e. actual data from Table I, have also been plotted. It is immediately apparent that in every case the actual frequency falls below the corresponding Poisson frequency. In Figs. 1*b*–1*f* the appropriate points have also been inserted and each graph shows that the actual data deviate from the Poisson curves. From all the graphs together it would appear that the observed data, in general, do not agree with the Poisson distribution, and hence that the pores are not distributed at random. Further support for this deviation from the Poisson distribution is given by the values for the means, M, and variances, V, shown in Table I. It is well known that for a Poisson distribution $M = V$, and since this is not so in Table I it follows once more that probably the data are not of the Poisson type.

Inspection of the points representing the actual data shows that for all six graphs they fall on fairly smooth curves, but not necessarily the full-line curves drawn in the Figure. The significance of these full-line curves will be seen later. At this stage the sweep of the points in each graph suggests that they may belong to some kind of distribution other than the Poisson. The next step was to look for this distribution.

Before doing so, it is important to observe that the data at the extreme ends of the range

corresponding to high and low means do not deviate from the remainder, although they were obtained in a somewhat artificial manner.

Further examination of the data showed that it is nearly always the two frequencies for events on each side of the mean count that have a frequency of occurrence greater than the Poisson value and that the rest of the events occur less frequently. For example, if the mean

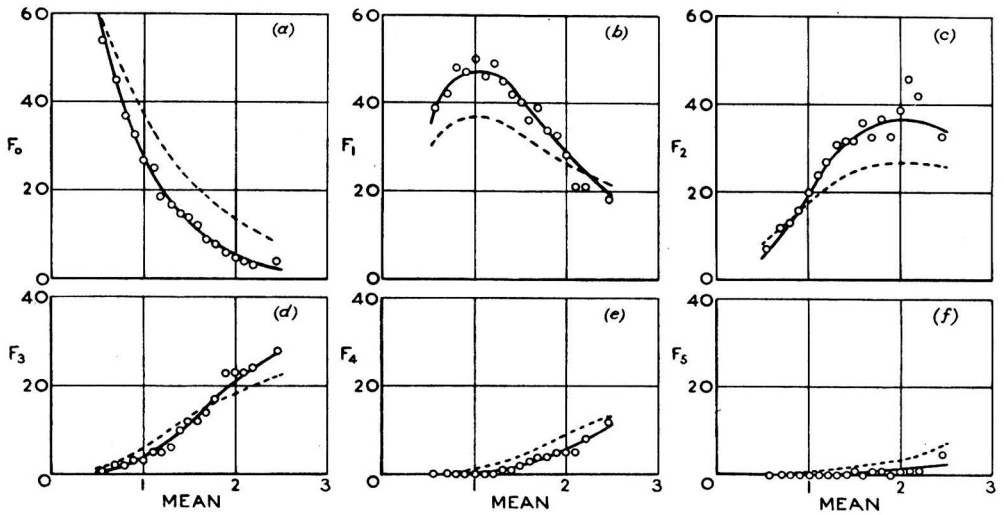

FIG. 1 (*a–f*).—*Relationship between the mean pore count/sq. mm. and frequency of occurrence of a particular event, i.e.* 0, 1, 2, 3, 4 *or* 5 *pores/sq. mm.* (*based on* 100 *counts*)

○ represents the actual data of Table 1
- - - - - - represents the Poisson distribution
——— represents the new distribution

number of pores is 1·5, then the frequency of occurrence of 1 and 2 events (i.e. 1 or 2 pores/sq. mm.) is too great when compared with the Poisson distribution, whereas the frequency of occurrence of 0, 3, 4, 5 and 6 events is too small. This result seemed to bear some relationship to the distribution known as negative binomial, so this was tested.

Relationship to the negative binomial distribution

Kendall[2] gives the formula of this distribution and certain details about it, but for ease of calculation it has been converted here into a form in which the frequencies are all expressed in terms of M and V.

Thus :

$$\left[\frac{M}{V}\right]^{M^2/(V-M)}\left[1 : \frac{M^2}{V} : \frac{M^2[M^2+(V-M)]}{2!\,V^2} : \frac{M^2[M^2+(V-M)][M^2+2(V-M)]}{3!\,V^3} \ldots\right]$$

gives the respective frequencies of occurrence of 0, 1, 2, 3 . . . events.

Frequencies corresponding to a series of means and variances were calculated for this distribution and plotted in a similar manner to those in Fig. 1, but are not shown. It was found that, for a given mean, small changes in the variance moved each curve slightly. There was no doubt, however, that these curves were much nearer to the actual data than were the Poisson curves, nevertheless when individual distributions were tested against the negative binomial, with the χ^2 test, the differences were significant. The negative binomial distribution is therefore not the correct one, although undoubtedly a better fit than the Poisson distribution.

A new distribution

Since there appeared to be some resemblance to a Poisson distribution it was decided to test the data to determine whether a new distribution could be found which was a modification of the Poisson type.

Suppose, for the purpose of illustration, that each shell surface is divided into sq. mm. areas and that pores are put into the shell one at a time until the total number of pores available for that particular shell are used up. In a Poisson distribution each square millimetre has an equal chance of receiving a pore and the number of pores already present does not alter the chances of further pores being added. Now in this problem it may be that the number of pores already present might affect the chance of others appearing on the same square

Table I

Data on the distribution of pores and the mean and variance of the distribution

Class interval	No. of eggs/class	Pores/sq. mm.		Mean distribution per 100 counts						
		Mean	Variance	0	1	2	3	4	5	6
0·35–0·64	16	0·55	0·44	54	39	7	1	0	0	0
0·65–0·74	13	0·70	0·56	45	42	12	2	0	0	0
0·75–0·84	16	0·80	0·55	37	48	13	2	0	0	0
0·85–0·94	8	0·90	0·63	33	47	16	3	0	0	0
0·95–1·04	13	1·00	0·63	27	50	20	3	0	0	0
1·05–1·14	23	1·10	0·72	25	46	24	5	0	0	0
1·15–1·24	19	1·18	0·66	19	49	27	5	0	0	0
1·25–1·34	16	1·30	0·76	17	45	31	6	1	0	0
1·35–1·44	21	1·40	0·80	15	42	32	10	1	0	0
1·45–1·54	6	1·49	0·94	14	40	32	12	2	1	0
1·55–1·64	8	1·59	0·96	12	36	36	12	3	0	0
1·65–1·74	5	1·68	1·06	9	39	33	14	4	1	0
1·75–1·84	5	1·79	1·05	8	34	37	17	4	1	0
1·85–1·94	3	1·89	1·00	6	33	33	23	5	0	0
1·95–2·04	4	2·00	0·97	5	28	39	23	5	1	0
2·05–2·14	3	2·09	0·90	4	21	46	23	5	1	0
2·15–2·24	12	2·19	1·04	3	21	42	24	8	1	1
2·25–2·94	12	2·44	1·44	4	18	33	28	12	5	1

Mean distributions are given to the nearest whole number.

millimetre. This concept was considered and a theoretical approach made to the problem on these lines, but soon the expression became too complicated to follow further. Therefore an empirical approach was made. Such an approach might give an expression which fits the data quite well, but clearly the more complex the expression the more unsuitable it will be for use. Even then it is merely an approximate mathematical expression which happens to fit certain facts and is not to be taken as a basis for some 'law'.

A number of tests were made, and finally one was found which appeared to be promising. It was based on the idea that

$$T_r = k_r P_r^{n_r}$$

where T_r is the frequency of occurrence of 0, 1, 2 . . . r pores (events) in the observed data and P_r is the corresponding frequency for the Poisson distribution, each taken over a series of means. Then k_r and n_r are constants, which may or may not vary for the different types of event.

Thus for no pores:

$$T_0 = k_0 P_0^{n_0}$$

and in the logarithmic form

$$\log T_0 = n_0 \log P_0 + \log k_0$$

This represents a straight line if $\log T_0$ is plotted against $\log P_0$. The points for $\log T_0$ and $\log P_0$ for each value of M in Table I were therefore plotted on a graph (not given). It was clear that these points agreed very well with a straight line, but it is important to remember

that the points corresponding to very small frequencies will not be as reliable as those corresponding to the larger frequencies. For this reason the line of best fit was not calculated statistically, but instead a straight line was drawn ' by eye ' ignoring the less reliable points. The process was repeated for the other values on the same graph, and it was clear that, generally speaking, the slopes of all these lines were very similar to each other, but that the intercepts were different.

The average value of the slope was 1·6 and the formula now becomes

$$T_r = k_r P_r^{1\cdot6}$$

where k_r varies with the count, but n_r of the previous formula becomes 1·6 for all values of r. Now k_0 was found to be 1·35, and k_1, k_2 and k_3 were 2·36, 3·04 and 3·24 respectively; k_4, k_5 and k_6 were less reliable and were therefore not included at this stage. The next step was to divide each term by:

$$T_0 = 1\cdot35P_0^{1\cdot6} = 1\cdot35(e^{-M})^{1\cdot6}$$

This made the relationship to the Poisson distribution clearer and gave the distribution as:

$$1\cdot35(e^{-M})^{1\cdot6}\left[1 : 1\cdot75\left(\frac{M}{1!}\right)^{1\cdot6} : 2\cdot25\left(\frac{M^2}{2!}\right)^{1\cdot6} : 2\cdot40\left(\frac{M^3}{3!}\right)^{1\cdot6} : k'_4\left(\frac{M^4}{4!}\right)^{1\cdot6} : k'_5\left(\frac{M^5}{5!}\right)^{1\cdot6} : k'_6\left(\frac{M^6}{6!}\right)^{1\cdot6}\right]$$

The calculation of various order differences was next made by using the coefficients of the first four terms, in the hope that reasonable values might be obtained for the rest of the coefficients k'_4, k'_5 and k'_6:

Coefficient	Differences		
	1st order	2nd order	3rd order
1·00	+ 0·75	− 0·25	− 0·10
1·75	+ 0·50	− 0·35	
2·25	+ 0·15		
2·40			

Various modifications in the differences were examined, and finally the value of 0·083 for the third-order difference was selected because this is one-third of 0·25, which in turn is one-third of 0·75. These differences then gave a set of values for the coefficients of 1·00, 1·75, 2·25, 2·42, 2·17, 1·42 and 0·08. The final formula for the distribution thus becomes:

$$1\cdot35(e^{-M})^{1\cdot6}\left[1 : 1\cdot75\left(\frac{M}{1!}\right)^{1\cdot6} : 2\cdot25\left(\frac{M^2}{2!}\right)^{1\cdot6} : 2\cdot42\left(\frac{M^3}{3!}\right)^{1\cdot6} : 2\cdot17\left(\frac{M^4}{4!}\right)^{1\cdot6} : 1\cdot42\left(\frac{M^5}{5!}\right)^{1\cdot6} : 0\cdot08\left(\frac{M^6}{6!}\right)^{1\cdot6}\right]$$

and the coefficients of each term can be expressed by

$$k_r = \frac{72 + 61r - 6r^2 - r^3}{72}$$

Therefore

$$1\cdot35\left(\frac{72 + 61r - 6r^2 - r^3}{72}\right)\left(\frac{M^r}{e^M r!}\right)^{1\cdot6}$$

is the general expression.

This distribution has been used to obtain the full-line curves also shown in Fig. 1, and it is clear that the agreement is very good indeed. The distribution has been tested against individual shell counts using the χ^2 test and it has given a very satisfactory fit in almost every case tested, including two shells, coot and Malayan hen (Rhode Island Red), data from which were not used in the original calculations. A selection of such tests based on counts on 100 pieces are shown in Table II.

Table II

Distribution of pores in a selection of egg shells : counts of 100 sq. mm.

Bird	Mean count	Distribution 0	1	2	3	4	5	6	χ^2	Significance at $P = 0.05$
Guillemot (*a*)	0·55	56	34	9	1	—	—	—	2·09	
Razorbill	0·75	36	54	9	1	—	—	—	3·13	
Guillemot (*a*)	1·00	29	45	23	3	—	—	—	0·36	
Razorbill	1·25	13	53	31	2	1	—	—	2·82	
Coot	1·50	8	45	36	11	—	—	—	0·94	
Hen	1·50	14	42	28	12	4	—	—	1·53	N.S.
Hen	1·75	9	35	36	13	6	1	—	0·08	
Pheasant	1·75	10	31	38	16	5	—	—	0·96	
Hen (Malayan)	2·00	5	29	40	16	7	3	—	2·59	
Hen	2·10	6	23	35	27	9	—	—	1·09	
Pheasant	2·58	2	17	30	28	18	5	—	1·37	

(*a*) Original shells without nitric acid treatment, giving low counts

Where adjacent values are underlined they have been grouped together for purposes of the χ^2 test, since it is advisable to have not less than 10 entries per class for this test.

Note

The χ^2 values assess the measure of agreement with the new distribution, and non-significance (N.S.) indicates that the agreement is good.

The two sets of data shown in the earlier paper[1] are given in Table III as more complete examples showing the lack of agreement with the Poisson distribution and the agreement with the new distribution.

It was pointed out above that the chances of a pore being placed on a particular unit area when adding more pores to a shell would always be the same if the distribution were at random, whatever the number of pores already on that area. It is possible to calculate the chances of a pore going to a certain area with this new distribution ; it has been found that not only does the chance of adding another pore vary with the number of pores already present on the area, but also with the mean number of pores per unit area. The question of

Table III

Frequency distribution of pore counts/sq. mm. for two different shells and a comparison with the Poisson and the new distribution

Count	Frequency (F) Actual	Poisson	New distribution
	Example 1		
0	11	39·1	15·0
1	70	82·2	86·0
2	140	86·5	119·6
3	74	60·6	72·8
4 and over	25	51·8	27·1
	320	320·2	320·5
	Mean = 2·10	$\chi^2 = 71{\cdot}9^{***}$	$\chi^2 = 7{\cdot}7$ N.S.
	Example 2		
0	80	136·5	72·4
1	255	210·9	255·2
2	209	162·9	218·2
3	72	83·9	81·6
4 and over	24	45·1	17·3
	640	639·3	644·7
	Mean = 1·55	$\chi^2 = 57{\cdot}2^{***}$	$\chi^2 = 4{\cdot}9$ N.S.

*** Significantly different from Poisson distribution at $P < 0.001$

N.S. Not significantly different from new distribution at $P = 0.05$

calculating a true distribution from first principles would thus be exceedingly complicated, if not impossible.

Finally it should be stressed that the expression for this distribution is true only over the range of means considered, i.e. about 0·5–2·5 pores/sq. mm., but that very few mean counts outside this range have yet been found. We have therefore a relatively simple expression which conveniently describes the distribution of pores in egg shells of, at least, a few species of birds. It does not, however, represent a law, but is simply a useful descriptive formula.

Discussion

The new distribution gives results where certain events happen more frequently than they would with a Poisson distribution, whereas others happen less frequently. With egg shells this shows itself as follows: the extreme counts, i.e. 0, 4, 5 and 6 pores, are always lower than they should be and other counts are lower or higher according to the mean value.

It is not possible for the mathematical analysis to explain what causes this state of affairs but a tentative suggestion based on the mechanics of the shell can be advanced.

Among all the observations made, including others not available when these calculations were completed, it has been noted that the maximum number of pores per square millimetre is 6, although there is ample space for many more if size alone is considered. It may therefore be that any greater number would so weaken the shell at that point that it would serve as the starting point for a crack. Similarly, but to a less and less extent, 6, 5 and 4 pores may cause weakness. On the other hand, square-millimetre areas devoid of pores would be strong and areas with one or two pores would still be strong but less so than no-pore areas. There would thus be a range of areas from very strong to very weak. The new distribution favours a reduction in the number of extremely strong and weak areas and an increase in the areas of average strength. Thus the result is a shell of more uniform strength than if the pores were distributed at random. If the argument is reversed and it is considered that the presence of pores gives strength and their absence gives weakness to a particular area of shell, nevertheless, the end result would be the same, namely that the new distribution would give a shell of more uniform strength.

By arranging the pores in a regular pattern the number of pores might be reduced to one or two in every square millimetre, but such a structure would tend to be weak because potential lines of fracture would already exist along the straight lines of pores thus formed. The form of distribution which appears to be best suited to strength is thus something between randomness and complete uniformity, and the one found is in this category.

In the discussion above somewhat mechanistic modes of expression have been used, but clearly the bird does not consciously allocate the pores to specific positions. Perhaps the present form of distribution developed by natural selection, because eggs with other distributions of pores hatched poorly or not at all. Thus the surviving birds would perhaps inherit the capacity to lay eggs having this form of distribution, and gradually all other types would disappear.

Finally it is of interest that these data, fitting so well together, have been derived from a number of quite different species of birds.

Acknowledgment

It is a pleasure to acknowledge the help given by Miss H. Stock in counting the pores and Dr. P. White for his comments and criticism throughout the work.

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Received 16 August, 1954

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JOURNAL OF THE SCIENCE OF FOOD AND AGRICULTURE

ABSTRACTS

MARCH, 1955

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

INDEX OF AUTHORS' NAMES

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JOURNAL OF THE SCIENCE OF FOOD AND AGRICULTURE

ABSTRACTS

MARCH, 1955

I.—AGRICULTURE AND HORTICULTURE

Soil types and agronomic practices in some important groups of soils in the Bombay State. J. K. Basu and V. D. Tagare (*J. Indian Soc. Soil Sci.*, 1954, **2**, 1—4).—A general discussion of the soil types of the region and agronomic practices associated with each soil type. A. H. CORNFIELD.

Characteristics of paddy soil profiles. S. P. Raychaudhuri and B. S. Banurjee (*J. Indian Soc. Soil Sci.*, 1954, **2**, 5—14).—Chemical and physical characteristics of four typical paddy soil profiles from different parts of India are described. A. H. CORNFIELD.

Characteristics of soils with fragipans in a podsol region. F. J. Carlisle (*Dissert. Abstr.*, 1954, **14**, 1861).—The soils studied are classified in the mardin and volusia series occurring in southern New York State. In both soils, a dense slowly permeable horizon occurs at a depth of 10—20 in. A study of the morphology of the soils and their relation to topography was made along 28 miles of freshly dug pipeline ditch. The upper solum of mardin is a typical podsol profile to a depth of about 15 in. Underneath is a light coloured coarser horizon 3—6 in. thick, the A'_2, and below that is the B′ horizon, 3 ft. thick, slowly permeable to water. Volusia consists of an A_1 horizon 4 or 5 in. thick underlain by A'_2 and B′ horizons. The characteristics of each soil are discussed and two profiles of each were sampled. A'_2 and B′ are considered to be genetic soil horizons; the B′ horizon is morphologically the same kind of horizon as the fragipans in other areas of the United States. The factors responsible for the observed properties of the pan horizon are discussed. E. M. J.

Binding force of water between soil particles. W. Gardner and J. H. Gardner (*Soil Sci.* 1954, **78**, 412—414).—A brief mathematical discussion of the wetting and drying of a viscous clay. T. G. MORRIS.

Accuracy of fibre-glass–gypsum blocks for measuring soil moisture changes. J. M. Stackhouse and R. E. Youker (*Agron. J.*, 1954, **46**, 405—407).—The accuracy of fibre-glass–gypsum blocks (*Trans. Amer. Geophys. Un.*, 1951, **32**, 447—449) for measuring soil moisture status was compared with that of the method of weighing monolith lysimeters. Both methods gave very similar results for soil moisture status over ~2·5 months regardless of whether soil moisture was increasing or decreasing. A. H. CORNFIELD.

Rapid methods of determining soil moisture. J. E. Garton and F. R. Crow (*Agric. Engng*, 1954, **35**, 486—487, 491).—In the " limit " sampling method a core sampler is adjusted to obtain samples with an average pre-determined dry wt. of 100 g., so that drying of the sample is eliminated. The method gave rather erratic results in practice. The pycnometer method, whereby the moisture content is calculated from the sp. gr. of the moist soil, gave results in fairly good agreement with those obtained by the oven method. An oven method employing infra-red heating has shown promise in cutting down the drying time of soil samples. A. H. CORNFIELD.

Rapid method for calibrating soil moisture elements of the porous block type. R. L. Closs (*Soil Sci.*, 1954, **78**, 333—338).—The calibration of gypsum block elements is based on the relation between the pF and freezing point of water in the pores of the block. Prepared blocks were saturated with water and then placed in a refrigerator until the water had frozen (temp. as measured by a thermocouple embedded in the block was constant). The resistance was measured at intervals throughout. The block was then removed and allowed to dry until the resistance had altered. The freezing was then repeated. Similar cycles were continued until the block was dry. The pF was calculated from the freezing point (corrected for depression due to dissolved $CaSO_4$) by the equation $pF = 4{\cdot}097 + \log \Delta T$, where ΔT is the freezing point depression. Calibrations agree well with those obtained by pressure membrane methods. T. G. MORRIS.

New type electrode for plaster of Paris moisture blocks. G. J. Bouyoucos (*Soil Sci.*, 1954, **78**, 339—342).—The electrode is a stainless steel (18-8) 20-mesh screen, 0·9375 × 0·25 in. Two of these are embedded in blocks 1·6875 × 0·6875 × 1·25 in., 0·375 in. apart with their flat faces parallel and at right angles to the plane of the block. The connecting wires are stainless steel soldered, and plastic coated. The blocks, after curing, are treated with nylon resin. It is claimed that the blocks are more uniform, mechanically stronger, more consistent in their performance, and with no capacitance. Soil moisture tension can be measured at field capacity. T. G. MORRIS.

Slide rule for correcting electrical resistance of soil moisture blocks. E. F. Rowland, T. D. Fagan, and G. A. Crabb, jun. (*Agron. J.*, 1954, **46**, 335).—A handy slide rule, which replaces cumbersome nomographs, for correcting the observed electrical resistance of soil moisture blocks to compensate for temp., is described. A. H. CORNFIELD.

Effects of different orchard cultural management practices upon availability of soil moisture. K. Roy Simons (*51st Ann. Mtg Amer. Soc. hort. Sci., Florida*, 1954, 24).—With orchards in grass, " cultivation " treatment resulted in less depletion of soil moisture than did mowing or leaving the grass untouched. L. G. G. WARNE.

Hygroscopicity measurements of soils. G. Rinno (*Z. PflErnähr. Düng.*, 1954, **66**, 156—160).—The hygroscopicity of a clay and a no. of soils were compared by allowing the samples to come to equilibrium with water vapour in a desiccator over (*a*) 10% H_2SO_4, (*b*) saturated aq. Na_2SO_4 in contact with solid $Na_2SO_4.10H_2O$. At 20° both methods gave very similar values for hygroscopicity for all the materials. At 10° and 30° the two methods gave different results. A. H. CORNFIELD.

***In situ* measurement of soil bulk density.** J. A. Vomocil (*Agric. Engng*, 1954, **35**, 651—654).—A method of determining the bulk density of soils, based on the measurement of the transmittancy of radiation from a source of radioactive Co placed in the soil, is described. The method gave results very similar to those obtained by the core sampling method. A. H. CORNFIELD.

Land drainage in California. W. W. Weir (*Agric. Engng*, 1954, **35**, 482—485).—The broad aspects of the history and development of land drainage in California are described and discussed. A. H. CORNFIELD.

Tile drainage field laboratory. J. van Schilfgaarde, R. K. Frevert, and D. Kirkham (*Agric. Engng*, 1954, **35**, 474—478).—The uses of a field laboratory for testing different spacings and depths of tile drainage are described. A. H. CORNFIELD.

Mechanism of ground water discharge. G. A. Whetstone (*Agric. Engng*, 1954, **35**, 646—647, 650).—A general review and discussion. A. H. CORNFIELD.

Determination of water flow from gated pipe. V. E. Hansen (*Agric. Engng*, 1954, **35**, 496—497).—A simple method for measuring the discharge of water from gated pipe during irrigation is described. A. H. CORNFIELD.

Temperature and evaporation at and near ground level on certain forest sites. O. Vaartaja (*Canad. J. Bot.*, 1954, **32**, 760—783).—At exposed sites of pine and spruce in Finland, a temp. range of 57° in 24 hr. was recorded in sandy surface soil. Extreme diurnal fluctuation in temp. is not closely correlated with general climate, but is favoured by dryness of the soil and the presence of ground cover (*e.g.*, humus and fine litter with low thermal conductivity). Max. temp. of 50—70° occur normally in surface soil at exposed sites in northern coniferous forests, but max. temp. may remain at 9—13° under canopy and surface cover, and night min. may be below 0°. A negative correlation was found between evaporation rate and drought injuries of plant in dry sites. Root competition was more important than evaporation conditions. R. H. HURST.

Influence of the polyelectrolyte CRD-186 on aggregation and other physical properties of some California and Israeli soils and some clay minerals. J. Hagin and G. B. Bodman (*Soil Sci.*, 1954, **78**, 367—378).—Four California soils were wetted to a stage when discrete clumps were present. The amount of water needed for this was increased by up to 100% in some cases if the soil was treated beforehand with 0·1% of CRD-186 (the Ca salt of *poly*vinyl acetate/maleic acid copolymer). On these soils and on 5 Israeli soils of varying clay content 0·1% of CRD-186 markedly increased the water-stable aggregates, especially when the polymer was hand mixed with soil. Mechanical mixing resulted in lowered aggregation. CRD-186 had little effect on the water retention–pressure relationships at high pressures (1—15 atm.), but under low pressures the polymer-treated soils retained less water than the untreated. Total porosity was unaffected in the Israeli soils by CRD-186. *X*-ray patterns of pure clay minerals and soil colloids showed no effect of CRD-186 on the

spacings. In mixtures of sand and either bentonite or kaolinite with and without CRD-186 increasing amounts of bentonite without CRD-186 increased the water-stable aggregates by 20% at a bentonite content of 50%, but kaolinite had no effect. 0·1% of CRD-186 increased the aggregates to 100% with 2·5% of either bentonite or kaolinite, there being then a decrease in aggregates as the clay mineral content increased. Complete aggregation could be achieved in mixtures of 25 g. of sand and up to 2·5 g. of either bentonite or kaolinite, indicating a surface effect of CRD-186.

T. G. MORRIS.

Soil conditioner trial under irrigation. B. O. French and F. J. Gardner (*Agric. Gaz. N.S.W.*, 1954, **65**, 84—86).—Application of Krilium (0·05—0·1%) to a soil (22% clay, 11% silt) which was subjected to torrential rainfall and irrigation greatly improved its physical condition in comparison with untreated soil. Treated plots absorbed irrigation water much more rapidly and showed much less caking and cracking on drying than did untreated plots. Total yields of beans were unaffected by the treatments even though beans matured earlier on treated plots. A. H. CORNFIELD.

Effects of synthetic soil conditioners on growth and yield of tomato plants. E. R. Wester (51*st Ann. Mtg Amer. Soc. hort. Sci., Florida*, 1954, 26).—Two synthetic soil conditioners (100% active material) were used on Sassafras silt loam, which packs hard and runs together after rains: VAM (partial Ca salt of vinyl acetate and maleic acid polymer) and HYPAN (Na salt of hydrolysed *poly*acrylonitrile). Approximately 65 g. of each was applied in mounds 2 ft. in diam. and mixed with the soil to a depth of 6 in. (equal to 2000 lb. per acre in each hill). The conditioners increased the fruit yield of tomatoes and maintained the soil in excellent structure.

L. G. G. WARNE.

Effect of soil conditioners on growth of horticultural crops and physical properties of Georgia soils. E. F. Johnstone, jun., H. D. Morris, and K. W. Hanson (51*st Ann. Mtg Amer. Soc. hort. Sci., Florida*, 1954, 25—26).—Applications of 250, 500, and 1000 lb. per acre of the active ingredient of a *poly*acrylonitrile type of soil-conditioner produced statistically significant increases of marketable Porto Rico sweet potato roots. The treatments also improved the physical condition of the clay. L. G. G. WARNE.

Physical properties affecting erosion of Madhya Pradesh soils. D. K. Ballal (*J. Indian Soc. Soil Sci.*, 1954, **2**, 37—41).—A no. of physical properties of 16 samples representing the main soil types of Madhya Pradesh are presented. The erosion ratio of the soils was highly correlated with percolation ratio, clay ratio, and clay/silt ratio. A. H. CORNFIELD.

Chemical weathering of silicates in soil formation. M. Fieldes and L. D. Swindale (*N.Z. J. Sci. Tech.*, 1954, **36, B**, 140—154).—The primary silicate minerals (of New Zealand) arranged in order of weathering stability and the stages in the formation of the secondary minerals are presented as a flow-sheet and are discussed in detail. If the parent mineral and the weathering stage is known for any soil, the nature of the clay constituents can be predicted. Amorphous hydrous Al_2O_3 and Fe_2O_3 are present in the early stages of the weathering of zonal soils and their presence is helpful in predicting the presence of minor constituents of a clay.

J. A. SUGDEN.

Ionic antagonism in exchange reactions of clays. II. Competition between two cations in the replacement of a third cation from clay salts. S. Mookerjee and S. K. Mukherjee (*J. Indian Soc. Soil Sci.*, 1954, **2**, 29—36).—The extent of replacement of the adsorbed cation on H-, Na-, K-, and Ba-bentonites by bi-ionic solutions of various mono- and di-valent cations was studied. The extent of replacement and the degree of adsorption of the replacing cations varied with the concn. and nature of the replacing cations as well as with the nature of the cation originally adsorbed on the bentonite. The relationship $m = \theta c^{\alpha}$ (where m = ratio of cation concn. in the displacing solution, c = corresponding ratio adsorbed on the clay, and θ and α are const.) fitted most of the data fairly well with $\alpha \cong 1$ and $\theta \cong 0{\cdot}5$.

A. H. CORNFIELD.

Adsorption of proteins by montmorillonite. H. Mukherjee (*J. Indian Soc. Soil Sci.*, 1954, **2**, 49—53).—The amount of gelatin or albumin adsorbed by a montmorillonite clay (base exchange capacity 113 mequiv. per 100 g.) increased with the quantity of protein in the aq. suspension and reached a max. when equal amounts of clay and protein were present. Variations of pH (1·3—6·4) had little effect on the amount of protein adsorbed. The base exchange capacity of the clay–protein complex decreased somewhat with increasing amount of protein adsorbed. The max. reduction in base exchange capacity occurred at the highest pH (6·1—6·4). From 0% to 23% of the adsorbed protein was recovered by treating the clay–protein complex with 0·1N-HCl. A. H. CORNFIELD.

Determination of exchangeable calcium and magnesium in carbonate soils. B. M. Tucker (*Aust. J. agric. Res.*, 1954, **5**, 706—715).—Previously described methods for this determination are criticised, and a new procedure which is free from the disadvantages of previous methods is outlined. The solubilities of Ca and Mg from $CaCO_3$, dolomite, and magnesite, in N-NH_4Cl in 60% ethanol, adjusted to pH 8·5 with NH_3, are comparable with those in air-free water. This solution is suitable for extraction of exchangeable metal cations from CO_3'' soils. A single extraction yields a solution in which $Ca^{\cdot\cdot}$, $Mg^{\cdot\cdot}$, $Na^{\cdot}$, and $K^{\cdot}$ may be determined by known methods. NH_4Cl is better than the acetate for the extraction.

R. H. HURST.

Specific surface and its relationships to some physical and chemical properties of soil. M. M. Mortland (*Soil Sci.*, 1954, **78**, 343—347).—A highly significant relationship was found between the total specific surface of soils (ethylene glycol method) and the cation exchange capacity, and between the total surface and the $<2\mu$. clay content. External specific surface correlated better than the internal with the $<2\mu$. clay. K extracted by 0·13N-HCl was not correlated with surface at all, but P extracted by 0·13N-HCl was significantly related to the external but not to the internal surface area. P extracted with 0·025N-HCl and 0·03N-NH_4F was not related to surface. The moisture retention at 27·12 atm., field capacity, and moisture equiv. correlated highly with specific surface, (especially the total). T. G. MORRIS.

Vapour losses from the pressure membrane apparatus. J. P. Quirk (*Soil Sci.*, 1954, **78**, 411—412).—Losses of air pressure through a Cellophane membrane have been measured, but they are not considered to be of importance in the Collis–George pressure membrane apparatus in the case of Na saturated montmorillonitic clay.

T. G. MORRIS.

Sources contributing to subsoil acidity in Florida citrus groves. I. W. Wander (51*st Ann. Mtg Amer. Soc. hort. Sci., Florida*, 1954, 36).—The source of N in fertilisers and the use of S sprays both affect soil acidity. S sprays and the use of $(NH_4)_2SO_4$ both tend to increase subsoil acidity. L. G. G. WARNE.

Errors involved in pH determination in soils. M. Raupach (*Aust. J. agric. Res.*, 1954, **5**, 716—729).—Errors of replication of pH values of 1 : 5 soil : water suspensions differ significantly between routine observers, and are larger when duplicate determinations are made on different days rather than on the same day. Errors due to soil variation over small distances in the field may show 5% limits as high as $\pm 1{\cdot}3$ units. Details are given of errors in soil systems due to the suspension effect and to lack of equilibrium between the soil and aq. phases. Absence of equilibrium may give differences as high as 1·0 when measurements are made upon sedimenting alkaline suspensions, but no errors are due to this below pH5. The pH measurements should be made with the glass electrode in the suspension and the reference electrode in the supernatant liquid. A suitable electrode arrangement is described. R. H. HURST.

Influence of orchard sods upon soil analysis. A. L. Kenworthy and J. Hinsvark (51*st Ann. Mtg Amer. Soc. hort. Sci., Florida*, 1954, 24).—Different cover crops exerted variable effects on the exchangeable Ca and Mg and on the acidity of orchard soils but they all decreased the exchangeable K. L. G. G. WARNE.

Estimation of the amount of calcium sulphate required for reclaiming black alkali soils rich in soluble salts. M. Y. Shawarbi and A. A. Abdel-Bar (*J. Indian Soc. Soil Sci.*, 1954, **2**, 15—20).—The quantity of $CaSO_4{,}2H_2O$ (in tons) to be added per acre (20 cm. depth) = vol. (in ml) of 0·02N-H_2SO_4 required to reduce the pH of 10 g. of soil to 8—8·3. A. H. CORNFIELD.

Use of radio-phosphorus for study of the distribution of saline solutions in the soil. J. Govaerts, A. Lecrenier, C. Corin, E. Dermine, O. Liard, and J. Trezinski (*Bol. Radiact.*, 1954, **26**, 45—70).—The technique of sampling is described and results obtained with a solution of radioactive $^{32}PO_4'''$ ions are shown by activity-contour graphs at various depths. Rainfall is only a minor factor affecting the distribution of the phosphate. D. LEIGHTON.

Diffusion of fertiliser phosphorus in soils. J. M. Heslep and C. A. Black (*Soil Sci.*, 1954, **78**, 389—401).—The rate of diffusion of P from a P fertiliser, tagged with ^{32}P, through moist soils was determined. In two silt loams the distance moved by the fertiliser P from the source increased with time and rate of P treatment. In most cases >50% of the total fertiliser P found in the soil after four weeks had diffused within the first week, and >90% in the first three weeks. Diffusion coefficients decreased with increasing time. The extent of P diffusion differed with the type of soil. In six acid soils no correlation was found between the extent of diffusion and the moisture equiv., exchangeable H, pH, total exchangeable bases, percentage base saturation, exchangeable Ca, fixation of P from solution or the P sol. in dil. NH_4F–HCl. The extent of diffusion was less in calcareous than in acid soils; it increased with water content of the soil, but compaction had no effect. Different fer-

tilisers showed rates of diffusion which increased with their water-sol. P contents. N and K salts decreased the diffusion of P from superphosphate. The uptake of P by oats was in accord with diffusion measurements; it was greater from NH_4 phosphate than from superphosphate. T. G. MORRIS.

Potash fixation by clay minerals. B. Chatterjee and A. Ray (*J. Indian Soc. Soil Sci.*, 1954, **2**, 63—65).—Montmorillonite fixed large amounts of added K during alternate wetting and drying, whilst kaolin fixed no added K. Chemical and *X*-ray data showed that about 15% of the montmorillonite was converted into illite, whilst the composition of kaolin was unaffected by the treatments. A. H. CORNFIELD.

Fate of cobalt applied to soils. G. K. Zende (*J. Indian Soc. Soil Sci.*, 1954, **2**, 67—72).—Fixation of applied Co in non-exchangeable form increased with soil pH and was greater in clayey than in sandy soils. Both rapid and slow fixation processes occur. The presence of 0·2% of quinol in the extracting solution increased the amount of Co extracted, indicating that added Co is oxidised to a higher valency state. A. H. CORNFIELD.

Effect of air-drying on the level of extractable manganese in the soil. G. K. Zende (*J. Indian Soc. Soil Sci.*, 1954, **2**, 55—61).—Air-drying of mineral field-moist soils increased their content of exchangeable Mn. This increase was greater with soils of low than those of high pH. Air-drying reduced the exchangeable Mn of calcareous peat soils. The exchangeable Mn content of air-dried soils increased considerably during 12 years' storage. There were no differences in the exchangeable Mn content between moist and air-dried soils in which the org. matter had been destroyed. Org. matter plays an important part in increasing the exchangeable Mn of soils during air drying. A. H. CORNFIELD.

Mulch farming. S. R. Cruz (*Araneta J. Agric.*, 1954, **1**, No. 3, 1—22).—The latest American practices are described and reviewed. The application of this type of farming in the Philippines is considered. T. G. MORRIS.

Mulching in relation to soil analysis. Shan Shue Kwong and A. L. Kenworthy (*51st Ann. Mtg Amer. Soc. hort. Sci., Florida*, 1954, 24—25).—Mulching of orchard soils decreased the exchangeable Ca and when N was applied the exchangeable Mg also. With no fertiliser, mulching increased the exchangeable Mg and increased the exchangeable K when N, NP, or NPK was given. Acetate-sol. P was increased by mulching when fertilisers were given. L. G. G. WARNE.

Nitrifiability of soil organic matter. C. N. Acharya and S. P. Jain (*J. Indian Soc. Soil Sci.*, 1954, **2**, 43—48).—The rate of mineralisation of N during the incubation of samples representing the major soil groups of India was studied. For a given soil type the extent of mineralisation of N was approx. ∝ the total N content of the soils. The org. N in black cotton soils and alluvial soils mineralised much more readily than did that in lateritic and red soils. The degree of mineralisation was not correlated with the total N content of the soils. Mineralisation rate was high during the first 3—4 months of incubation but slowed up considerably with longer periods of incubation; after leaching with water active mineralisation again occurred on incubation. Accumulation of NO_3' and pH changes were not responsible for reduced mineralisation rate. Water-sol. bacterial toxins were the most likely cause of this reduction. A. H. CORNFIELD.

Effect of certain inorganic salts on soil nitrification rate of two south Australian soils. F. M. Collins (*Aust. J. agric. Res.*, 1954, **5**, 688—701).—Using the soil perfusion technique, the nitrification rate was low in both a clay loam and a sandy gravelly loam. The addition of $CaCO_3$, either alone or with PO_4''' and trace elements, increased the nitrifying capacity of both soils, but PO_4''' or trace elements alone had little effect on the rate. The addition of $CaCO_3$, PO_4''', and trace elements was followed by max. nitrification in both soils. A transient increase in NO_2'-N was recorded for soils treated with $CaCO_3$, and NH_3-N was removed from the perfusate in a no. of stages. R. H. HURST.

Nitrite oxidation by *Nitrobacter winogradski*. H. Engel, E. Krech, and I. Friederrichsen (*Arch. Mikrobiol.*, 1954, **21**, 96—111).—The growth of *N. winogradski* is inhibited by the presence of phenanthroline, 2 : 4-dinitrophenol, streptomycin, or by the absence of Fe or Zn, or of CO_2, whilst NO_2'-oxidation is relatively unaffected by these factors. The effects observed with phenanthroline (inhibition of growth is reversed on the addition of $FeSO_4$) indicate that NO_2'-oxidation is not conditioned by the presence of Fe or Zn. Paper-chromatography of the HCl hydrolysate of *N. winogradski* reveals the same NH_2-acid composition as has been found by other authors for *Nitrosomonas*. (30 references.) P. S. ARUP.

Partial segregation of bacteria and isolation of *Pythium* from coarser soil fractions. H. R. Angel (*Aust. J. agric. Res.*, 1954, **5**, 702—705).—The greater proportion of *Pythium* is concentrated in the coarser portion of the soil, most of the bacterial population being in the colloidal part. The separation of bacteria and fungi facilitates the isolation of *Pythium*. R. H. HURST.

Antigenic analysis of some plant and soil Corynebacteria. S. A. Rosenthal and C. D. Cox (*Phytopathology*, 1954, **44**, 603—604).—A differentiation between several strains of four Corynebacteria is described. T. G. MORRIS.

Willcox's agrobiology. C. A. Black, O. Kempthorne, and W. C. White (*Agron. J.*, 1954, **46**, 303—315).—A series of three papers describing critical studies of the three important concepts of O. W. Willcox's "quantitative agrobiology." (See next abstract.) A. H. CORNFIELD.

Quantitative agrobiology. O. W. Willcox (*Agron. J.*, 1954, **46**, 315—328).—Replies to criticisms (see previous abstract). Four papers. A. H. CORNFIELD.

Building up of soil fertility by phosphatic fertilisation of legumes. Influence of a legume rotation on the microbiological properties of the soil. C. N. Acharya and J. Jha (*J. Indian Soc. Soil Sci.*, 1954, **2**, 21—28).—Soils from plots where berseem had been included in a wheat–soya-bean rotation had higher bacterial no., ammonifying and nitrifying powers, and showed a higher rate of evolution of CO_2 than did control plots. Application of superphosphate (32—64 lb. P_2O_5 per acre) to the berseem plots increased most of these values still further. The N-fixing capacities of the soils were increased only slightly by the treatments. A. H. CORNFIELD.

Fertility and productivity of a podsolic soil as influenced by subterranean clover (*Trifolium subterraneum*, L.) and superphosphate. C. M. Donald and C. H. Williams (*Aust. J. agric. Res.*, 1954, **5**, 664—687).—Initially the most acute deficiencies affecting plant growth are those of P and N, with a less pronounced deficiency of S. After several years of superphosphate and clover, each deficiency is much reduced, the order of deficiencies then being: N > S > P. Soil pH falls with superphosphate application at the rate of 0·06 units per cwt. of fertiliser per acre, but may reach an equilibrium value at about pH 5·1. A field experiment on two sites also indicated the increase in fertility under clover pasture and demonstrated the capacity of the improved soils to produce a satisfactory crop of oats. R. H. HURST.

Fertility status of the cocoa and coffee soils of Costa Rica. F. B. Sands (*Dissert. Abstr.*, 1954, **14**, 1865).—Soil samples taken to a depth of 2 ft. were analysed, and leaf samples were examined for the same cations as those found in the soil in addition to P. Coffee soils, derived from recent alluvium, lacustrine deposits, and volcanic material, all in different stages and degrees of weathering, had a wider range of properties than the cocoa soils which were all coastal alluvial soils exposed to the soil-forming processes for the same length of time. Data on the two soils are discussed. *E.g.*, the average total N was 42% higher in the coffee soils than in the cocoa soils; significant relationships existed between soil and leaf analyses in coffee with Ca, Mg, K, but this was not the case with cocoa. E. M. J.

Relative efficiency of lattice and randomised block designs for forage crop trials. C. P. Wilsie (*Agron. J.*, 1954, **46**, 355—357).—Lattice design experiments with forage crops were 39—64% more efficient than were randomised block designs. Four replicates in a lattice design gave approx. the same precision as did six replicates in randomised blocks. A. H. CORNFIELD.

Production and use of fertilisers. Some current trends and problems. E. M. Crowther (*Chem. & Ind.*, 1954, 1400—1415).—The past and present use of fertilisers throughout the world is surveyed. The amounts of N, P, or K used and the forms in which they are applied are discussed. To avoid the confusion caused by the wide variety of mixed fertilisers at present available, a series of 3 NP, 3 PK, and 8 NPK standard mixtures with uniform limits of variation is proposed. The requirements of certain agricultural areas in different parts of the world are considered. A. M. SPRATT.

Thermal treatment of calcium phosphates and natural apatitic phosphates. F. Trombe and M. Foex (*Bull. Soc. chim. Fr.*, 1954, 1282—1287).—The effect on the solubility in citric acid and aq. NH_4 citrate of the fusion of phosphates in the solar furnace (2·5 kw.) alone and in the presence of SiO_2 and CaF_2 is studied as a measure of their assimilation by plants. The powdered minerals are fused in the furnace in contact only with unfused mineral and then either cooled suddenly with water, allowed to cool in air, or reheated to 1100° and then cooled slowly. In all cases the solubility in 2% citric acid is a max. for the composition $3CaO,P_2O_5$. Reheating at 1100° reduces the solubility when there is a higher proportion of CaO, since oxy- and hydroxy-apatites are formed. The effect on solubility in aq. NH_4 citrate at pH 9·5 is also studied, and is found

to be much more sensitive to grain size. The addition of SiO_2 to the mineral when fused augments the solubility by removal of apatitic phosphates (removing the CaO in excess of the tricalcium phosphate). In a dry atmosphere fusion with CaF_2 lowers the solubility which is then approx. proportional to the amount of phosphate not present as fluorapatite. In a moist atmosphere the solubility is even more reduced by formation of a hydroxyfluorapatite. The removal of F is therefore a necessary but not a sufficient condition for solubilisation by fusion. Results are given for the defluoration of a number of natural phosphates by fusion with SiO_2. The max. percentage of CaF_2 tolerable for assimilation is 0·5%. E. J. H. BIRCH.

Anatomical structure and its relation to the accumulation of radio-isotopes with regard to fertiliser placement. R. Langston (*51st Ann. Mtg Amer. Soc. hort. Sci., Florida*, 1954, 40).—The test plants were potato, tomato, and peppermint. ^{45}Ca and ^{32}P were applied in nutrient solution to selected roots. P and Ca require approximately two weeks to become distributed uniformly throughout the plants. L. G. G. WARNE.

Fertiliser–pesticide mixtures. K. D. Jacob (*J. Agric. Food Chem.*, 1954, **2**, 970—976).—The present status of these mixtures in U.S.A. is described and problems in their manufacture and use are discussed, with special reference to combinations of solid materials for the control of soil insects. (60 references.) S. C. JOLLY.

Nitrogen loss in drying of ammoniated superphosphate and mixed fertilisers. G. L. Bridger and H. A. Burzloff (*J. Agric. Food Chem.*, 1954, **2**, 1170—1173).—Temp. is the most important factor affecting N loss (up to 15—20%) during drying of ammoniated superphosphates and mixed fertilisers, but the loss can be reduced almost completely by careful control of product temp. (the most important) and of air-inlet temp. Quick-cured superphosphate is as satisfactory as storage-cured for ammoniation and mixing. N losses may be great if dryers are not designed for heat-sensitive materials. K losses are negligible, and reversion of available P_2O_5 infrequent. S. C. JOLLY.

Nitrogen availability in composted town refuse. H. Kick (*Z. PflErnähr. Düng.*, 1954, **66**, 132—142).—The availability of N from composts prepared in various ways from town wastes was studied by comparing yields of plants in pots treated with the composts with those obtained by applying an equiv. amount of NH_4NO_3 (**I**). Yields of cereals were affected only slightly in the first year by the composts whereas **I** increased yields 5-fold. In the following year the residual action of all the materials increased yields somewhat, but that of compost was less effective than that of **I**. In the third year the residual effect of N was low for all materials. In field tests extending over a no. of years the town compost " mull-humus " was almost as effective as was stable manure in increasing yields of a no. of crops. None of the materials were as effective as was a complete inorg. fertiliser. A. H. CORNFIELD.

Less-soluble boron compounds show promise as fertiliser supplements. N. R. Page and W. R. Paden (*Agron. J.*, 1954, **46**, 337—338).—The application of a synthetic borosilicate (5% B_2O_3) at 100 lb. per acre increased yields of green forage and seed of crimson clover to a greater extent than did that of colemanite ($Ca_2B_6O_{11}$, $5H_2O$). Another borosilicate was not quite so effective. The treatments increased the B content of the plants. Since even excessive rates of these borosilicates do not produce B-toxicity symptoms in B-sensitive crops, they could probably be safely mixed with and generally applied with other fertilisers. A. H. CORNFIELD.

Effects of fertilisation on subsequent damage of smog. R. F. Brewer, J. C. Kaudy, and J. T. Middleton (*51st Ann. Mtg Amer. Soc. hort. Sci., Florida*, 1954, 22).—Several important field crops including sugar beets, Romaine lettuce, and Pinto beans were differentially fertilised prior to exposure to oxidation products of unsaturated hydrocarbons (artificial " smog "). The data thus obtained for Romaine lettuce indicated that heavy NP or NPK applications produced a healthy vigorous type of growth which predisposed the crop to greater damage. Similar results were obtained with sugar beets. L. G. G. WARNE.

Use of agricultural limestone. I. Chemical and physical properties of South Island (N.Z.) agricultural properties. B. L. Elphick (*N.Z. J. Sci. Tech.*, 1954, **36, A**, 134—166).—A survey with 25 references. G. HELMS.

Simple determination of boron in plants by 1 : 1′-dianthrimide. H. Baron (*Z. anal. Chem.*, 1954, **143**, 339—349).—Small amounts of boric acid are determined colorimetrically to ±2% accuracy using the blue compound formed with 1 : 1′-dianthrimide in conc. H_2SO_4. The max. sensitivity is given with 2·5 ml. of aq. test solution to 17·5 ml. of H_2SO_4, the blue colour completely developing in 5 hr. at 70°. D. R. GLASSON.

Spectroscopy of plant pigments. I. Ethyl chlorophyllides *a* and *b* and their pheophorbides. II. Methyl bacteriochlorophyllide and [methyl]bacteriochlorophyll. A. S. Holt and E. E. Jacobs (*Amer. J. Bot.*, 1954, **41**, 710—717, 718—722).—I. Full details are given for the prep. of *a* and *b* ethyl chlorophyllides from the leaves of *Ailanthus altissima*, their separation and purification by column-chromatography on sucrose, and their conversion into the corresponding pheophorbides. Absolute molar extinction curves in the range 200—700 mμ. are given for the above four compounds in ether solution. Replacement of the phytol group by Et (as occurs during the extraction of the leaves with EtOH) has little or no effect on the molar extinction coeff in ether, acetone, or dioxan solution.

II. Full details are given for the extraction of bacteriochlorophyll from *Rhodospirillum rubrum*, its conversion into methyl bacteriochlorophyllide by means of chlorophyllase in presence of MeOH, and the purification of the above two compounds by column-chromatography on sucrose. Absolute extinction curves are given for these compounds in ether solution, and also for a green product (possibly 2-acetylchlorophyll *a*) formed by oxidation of bacteriochlorophyll in solution. P. S. ARUP.

Porphyrin pigment from photosensitive non-chlorophyllous plant tissues. G. W. Todd and A. W. Galston (*Plant Physiology*, 1954, **29**, 311—318).—An olive-green pigment was found in several non-chlorophyllous plant organs, mainly seeds. Absorption and fluorescence spectra of the pigment extracted from bluegrass seed are described. The pigment is probably a metal-free porphyrin similar to or identical with Me pyropheophorbide-*a*. The pigment may be involved as a photoreceptor in red-light-sensitive processes. A. H. CORNFIELD.

Plastid pigments of *Pedinomonas* (*Protochloridales*). R. Harder and W. Koch (*Arch. Mikrobiol.*, 1954, **21**, 1—3).—The plastid pigments of *P. tuberculata* are shown by paper-chromatographic and spectrophotometric methods to include both chlorophyll-*a* and -*b*. P. S. ARUP.

A simple technique for the application of unknown material in paper chromatography. E. W. Clark (*J. econ. Ent.*, 1954, **47**, 934).—A rapid means of processing comparatively large vol. of very dilute amino-acids for chromatographic analysis using small discs of filter paper is described. The paper discs were placed on a glass plate and the points of filled pipettes rested on these discs. The liquid flowed into the disc until saturated and the rate of flow was governed by the rate of evaporation. Prepared discs were sewn to the large filter paper sheets used for the chromatograms and were then processed by the routine chromatographic techniques. A. A. MARSDEN.

Identification of sugars in fruits by paper chromatography. G. S. Siddappa and B. S. Bhatia (*Indian J. Hort.*, 1954, **11**, 19—23).—A method utilising Whatman No. 1 filter paper and a solvent containing *n*-butanol, acetic acid, and water is described. The chromatogram is developed with benzidine (0·5 g.) in glacial acetic acid (10 ml), 10% trichloroacetic acid (10 ml.), and abs. EtOH (80 ml.). Tabular data of sugars in 25 different fruits and fruit parts are presented. E. G. BRICKELL.

Non-contaminating nylon slip-roll pulveriser for grinding dry plant samples. A. E. Kretschmer, jun., and J. W. Randolph (*Anal. Chem.*, 1954, **26**, 1862).—The apparatus consists of three roughened nylon rollers which pulverise dry plant samples without risk of contamination with most of the elements for plant growth. A. J. MEE.

Ferulic, sinapic, and related acids in leaves. E. C. Bate-Smith (*Chem. & Ind.*, 1954, 1457—1458).—In the hydrolysates from a large no. of monocotyledonous and dicotyledonous plants the most commonly occurring blue-fluorescent constituents are caffeic, *p*-coumaric (*p*-hydroxycinnamic), sinapic, and ferulic acids. They are identified by their appearance in u.v. light under acid, alkaline, and neutral conditions, and by chemical tests. A. M. SPRATT

[A] Synthesis of a compound with folic acid activity by *Lactobacillus arabinosus*, 17-5. [B] Synthesis of a substance exhibiting citrovorum factor by *L. arabinosus* 17-5. V. B. Mitbander and A. Sreenivasan (*Arch. Mikrobiol.*, 1954, **21**, 60—68, 69—79).—[A] A compound with folic acid activity is synthesised from *p*-aminobenzoic acid by the growing (on agar medium) or the respiring (in suspension) cells of *L. arabinosus*; in the latter case, the presence of glutamic acid is essential for the synthesis. The synthesis reaches a max. within 48 hr., and the folic acid activity is found mainly in the culture filtrate. Biotin, Tween-80, and xanthine stimulate the synthesis, whilst sulphanilamide inhibits it. (26 references.)

[B] A citrovorum factor having properties intermediate between those of pteroylglutamic acid (**I**) and the natural citrovorum factor is synthesised from *p*-aminobenzoic acid by the growing or respiring cells of *L. arabinosus*, with **I** as an intermediate step. The syn-

thesis is stimulated by ascorbic acid and (in the presence of ascorbic acid) by formate or "formyl" precursors. (36 references.)
P. S. ARUP.

Electron-microscopical observations of characteristic fine-structures of lignified conifer tracheids. W. Liese and I. Johann (*Planta*, 1954, **44**, 269—285).—The presence of wart-like structures (10—280 mμ. in diameter), irregularly distributed on the cell-walls of the tertiary lamella, is recorded for 9 out of 19 sp. of *Pinus*, 6 out of 6 sp. of *Abies*, but not for any of the sp. of *Larix* or *Picea* under examination. The structures are characterised as genuine constituents of the lignified cell-wall. P. S. ARUP.

Physiology of stomata. I. Carbon dioxide fixation in guard cells. Michael Shaw and G. A. Maclachlan (*Canad. J. Bot.*, 1954, **32**, 784—794).—The chlorophyll content of guard cells was about $0{\cdot}5 \times 10^{-12}$ g. per cell. Using radioactive CO_2, uptake in the light was demonstrated in stomata of *Allium, Hordeum, Nicotiana, Sedum, Tradescantia, Tulipa*, and *Vicia*. Small uptake in darkness was noted for *Allium, Sedum, Tulipa, and Vicia*. The rate of guard-cell photosynthesis was about $0{\cdot}02 \times 10^{-12}$M. CO_2 per cell per hr. at 500 ft.-candles, and in 0·04% CO_2. The rate was too low to account for the increase in osmotic potential due to illumination.
R. H. HURST.

***In vitro* cultures of plant embryos and factors controlling their growth.** J. Rappaport (*Bot. Rev.*, 1954, **20**, 201—225).—A review with a bibliography of over 100 references. L. G. G. WARNE.

Translocation of radioactive isotopes from various regions of roots of barley seedlings. H. H. Wiebe and P. J. Kramer (*Plant Physiology*, 1954, **29**, 342—348).—Translocation in the roots of the radioactive isotopes of P, S, Ca, Rb, I, and Sr supplied to various regions of the roots of barley seedlings was studied. Little upward translocation occurred when the isotopes were supplied to the tips of the roots, whilst the greatest translocation occurred when they were supplied in the region 30 mm. from the root tips. All isotopes moved down to the tips; P and S moved the most readily and accumulated in the tips. Killing the tissue in one portion of the root affected translocation not only in this portion but above and below it also. A. H. CORNFIELD.

Fixation of nitrogen and utilisation of combined nitrogen by *Nostoc muscorum*. W. E. Magee and R. H. Burris (*Amer. J. Bot.*, 1954, **41**, 777—782).—Examination of the N-fixation and of the N-utilisation metabolism of the alga by means of a ^{15}N technique reveals a mutual similarity between the fixation of N_2 and the utilisation of KNO_3- and of NH_4Cl-N, as well as a general resemblance to known cases of N-fixation by other organisms. An adaptation period is required for the utilisation of KNO_3; the composition of the cells is not altered by short exposure to the KNO_3 or NH_4Cl medium. Cultivation in the KNO_3 medium give notably high concn. of ^{15}N in the cytosine, guanine, uracil, and xanthine fractions. No free NH-acids are excreted into the medium.
P. S. ARUP.

Chemistry of the living bark of the black locust in relation to its frost hardiness. VII. Possible direct effect of starch on the susceptibility of plants to freezing injury. D. Siminovitch and D. R. Briggs (*Plant Physiology*, 1954, **29**, 331—337).—There was usually poor correlation between the sol. sugar content of the cells of the bark of black locust and frost hardiness. On the other hand, frost hardiness was usually negatively correlated with the starch content of the cells. A. H. CORNFIELD.

Effect of temperature and soil moisture at harvest and of delay in curing on keeping quality of Porto Rico sweet potatoes. L. J. Kushman, M. T. Deonier, J. M. Lutz, and B. Walters (*Proc. Amer. Soc. hort. Sci.*, 1954, **63**, 415—419).—When curing is done promptly after harvest, soil moisture and temp. do not affect the keeping qualities unless the harvest is after a long cold wet period. Delays in curing are detrimental and especially so if the crop is harvested during cold wet weather. L. G. G. WARNE.

Response of Great Lakes lettuce to night temperature following seed vernalisation. A. L. Rappaport and S. H. Wittwer (*51st Ann. Mtg Amer. Soc. hort. Sci., Florida*, 1954, 27).—With night temp. of 21° subsequent to vernalisation seedstalks were produced directly while non-vernalised plants first developed loose heads, and then seed talks at a later date. Controls (not vernalised) grown at 21° required a significantly greater no. of days to produce floral primordia. Vernalised plants grown at 18·3° produced seed stalks later than those which were vernalised and grown at 21° while all the non-vernalised plants grown at 18·3° formed marketable heads with no seedstalks. It was found that 28 and 35 leaves formed before the appearance of inflorescence primordia on vernalised plants grown at 21° and 18·3° respectively, with an average of 42 leaves on those not vernalised. At 21° the no. of leaves preceding anthesis of the first flower was 62 on the vernalised plants and 68 on the non-vernalised plants. L. G. G. WARNE.

Effects of high temperature during the breaking of the rest of Sullivan Elberta peach buds. J. H. Weinberger (*Proc. Amer. Soc. hort. Sci.*, 1954, **63**, 157—162).—Exposure of peach buds to high temp. during the dormant period delays the subsequent opening of both leaf and flower buds. Fruit set was also reduced.
L. G. G. WARNE.

Chrysanthemum temperature study. IV. Effect of temperature shifts on the flowering of *Chrysanthemum morifolium*. M. H. Cathey (*51st Ann. Mtg Amer. Soc. hort. Sci., Florida*, 1954, 31).—A sudden drop in temp. induced the formation of crowned sprays with laterals. The same effect was produced if the period of short days was interrupted by 15 long days (followed by short days until flowering).
L. G. G. WARNE.

Effect on ecological measurements of carbon dioxide assimilation of overheating of leaves during prolonged exposure to sunlight in respiration chambers. W. Tranquillini (*Ber. dtsch. bot. Ges.*, 1954, **67**, 191—204).—The high temp. prevailing in the chambers during prolonged exposure to sunlight cause abnormal respiration and assimilation. Preliminary experiments to remedy this defect include the use of special optical glass for the construction of the chambers, and the maintenance of a current of air through the chambers, in connexion with an automatic (URAS) CO_2-recorder.
P. S. ARUP.

Photoperiod and flowering of *Chrysanthemum morifolium*. T. Furuta (*51st Ann. Mtg Amer. Soc. hort. Sci., Florida*, 1954, 31).—Plants of four chrysanthemum varieties were grown under various combinations of 10—11, 12, 13, 14, 15, and 16-hours photoperiods. Photoperiods under 14 hours duration, but not those >14 hours, caused flower bud initiation. A shorter photoperiod was needed for max. rapidity of flowering than was needed for flower bud initiation. Flower bud development was delayed by photoperiods of 13 hours or over. Varietal differences were noted. The later a variety flowers the shorter the photoperiod necessary for both initiation of flower buds and max. rapidity in flower bud development. At photoperiods near the max., full open flowers and small flower buds were present on the same stem. This was not so for shorter photoperiods. L. G. G. WARNE.

Effects of various light intensities on the photosynthetic ability of *Chrysanthemum morifolium*. M. H. Cathey (*51st Ann. Mtg Amer. Soc. hort. Sci., Florida*, 1954, 31).—Production of sugar under different light intensities was tested in 6-week (White Wonder), 8-week (Pristine), 10-week (Encore), 12-week (Fortune) and a 15-week (Revelation) variety. The light intensity was adjusted by the use of 1, 2, and 6 layers of cheesecloth. The earlier varieties produced a higher concn. of reducing sugars per g. of dry wt., regardless of the light intensity. Early varieties were efficient and late varieties inefficient users of light in production of carbohydrates.
L. G. G. WARNE.

Photoperiodic responses in hydrangeas. A. A. Piringer and W. N. Stuart (*51st Ann. Mtg Amer. Soc. hort. Sci., Florida*, 1954, 30).—Flower primordia formed on plants given 8 to 18 hr. per day and continuous light during the summer. Long days increased the height of the plants. L. G. G. WARNE.

Some effects of artificial light, cold storage, and disbudding on flowering of greenhouse hydrangeas. W. N. Stuart (*51st Ann. Mtg Amer. Soc. hort. Sci., Florida*, 1954, 30—31).—Storage of hydrangeas at 10°, 15·5°, or 18·3° with low light for 12 hours per day for 1—4 weeks followed by 6-weeks' storage at 1·7° accelerated flowering.
L. G. G. WARNE.

Photoperiodic responses of peppermint. R. Langston and A. C. Leopold (*Proc. Amer. Soc. hort. Sci.*, 1954, **63**, 347—352).—*Mentha piperita* is a long-day plant with a critical photoperiod of 16—18 hours. Long days increase the no. of oil glands on the leaf and no oil could be obtained from plants grown under photoperiods of 14 hours or less. L. G. G. WARNE.

Effect of quality and quantity of light on composition of cranberries. H. Gorfien, F. B. Chandler, and W. B. Esselen (*51st Ann. Mtg Amer. Soc. hort. Sci., Florida*, 1954, 34—35).—A decrease in the intensity of light by natural or artificial means resulted in cranberries that were lower in pectin and higher in total acid content. The cranberries that developed under coloured glass were yellowish and had only a slight tinge of red colour. Fewer cranberries were produced under violet glass than under green glass. L. G. G. WARNE.

Effects of fluorescent and natural light on reproductive and vegetative growth in *Saintpaulia*. R. H. Hanchey (*51st Ann. Mtg Amer. Soc. hort. Sci., Florida*, 1954, 32).—Controlled fluorescent-light intensity treatments of 100, 300, and 600 ft.-candles of 6, 12, and 18 hours duration, and natural light treatments of 300, 500, 700, 900, 1100, and 1300 ft.-candles were used on *Saintpaulia ionantha*, variety Orchid Wonder. Plants exposed to 600 ft.-candles of fluorescent light for 18 hours daily produced more flowers than did plants

under any other treatment. 100 ft.-candles for 6 hours duration produced the least no. of flowers and delayed floral initiation.
L. G. G. WARNE.

Photoperiodic responses in coffee. A. A. Piringer and H. A. Borthwick (*51st Ann. Mtg Amer. Soc. hort. Sci., Florida*, 1954, 38).—The critical photoperiod for flower initiation is 13—14 hours. Flower initiation occurred in day lengths $\geq$13 hours but not in those of >14 hours. Longer photoperiods made the lateral shoots significantly longer than those of plants grown on short days. This increased lateral shoot length was due to both increased node number and increased internode length. L. G. G. WARNE.

Influence of light intensity on vegetative and reproductive growth of common camellia. E. W. McElwee (*51st Ann. Mtg Amer. Soc. hort. Sci., Florida*, 1954, 31—32).—High as compared with low light intensity increased the percentage of normal flowers. Twig growth was greater and leaf size greater in plants under low than in those under high light intensity. Plants grown under a continuously low photoperiod and high light intensity bloomed in a shorter time than plants grown under the same photoperiod and a low light intensity. L. G. G. WARNE.

Growth and leaf analysis of Montmorency cherry trees as influenced by solar radiations and intensity of nutrition. E. L. Proebsting, jun., and A. L. Kenworthy (*Proc. Amer. Soc. hort. Sci.*, 1954, **63,** 41—48).—Max. growth was obtained with full exposure to sunlight. Reduction in solar radiation diminished growth and lowered the level of nutrition necessary for max. growth.
L. G. G. WARNE.

Dark metabolism of a golden-brown alga, *Ochromonas malhamensis* G. H. Reazin, jun., (*Amer. J. Bot.*, 1954, **41,** 771—777).—The kinetics of endogenous respiration of the alga indicate dependence on one substance, which, judging by the R.Q. (<1) is probably not a carbohydrate. Starvation in darkness exhausts the endogenous factors for carbohydrate metabolism; a time-lag, depending on the length of the starvation period, occurs after the addition of glucose, for the restoration of the above factors. After starvation in light, the time-lag is not observed. Endogenous respiration is restored after starvation, more rapidly by yeast-extract than by glucose; the formation of induced (adaptive) enzymes from fatty constituents of yeast is indicated. P. S. ARUP.

Effect of chloride and sulphate on the enzyme activity of plants. E. Latzko (*Z. PflErnähr. Düng.*, 1954, **66,** 148—155).—The carbohydrate-decomposing enzymes present in plants (potatoes, sugar beet, spinach, beans, and barley) grown with SO_4'' in the nutrient solution were more active than were those present in plants receiving Cl'. A. H. CORNFIELD.

Relationship between salt- and water-uptake in Jerusalem artichoke tuber tissue. J. B. Hanson and J. Bonner (*Amer. J. Bot.*, 1954, **41,** 702—709).—Additions of 2 : 4-D to 0·001M-RbCl cause very slight increases in the Rb-uptake by the tissue, in comparison with the considerable increases in water-uptake. Treatment of the tissue with aq. 2 : 4-D prior to immersion in aq. RbCl causes a transient initial lag in the water-uptake, and an increased Rb-uptake during the first hr., followed by a decreased uptake in comparison with that of the untreated tissue. Water- and Rb-uptake proceed independently, and affect one another only indirectly. (42 references.) P. S. ARUP.

Nitrogenous constituents of sap exuded from the sapwood of *Acer saccharum*. J. K. Pollard, jun., and T. Sproston (*Plant Physiology*, 1954, **29,** 360—364).—The nitrogenous constituents of the syrup and lyophilised sap before and after hydrolysis are reported.
A. H. CORNFIELD.

Growth and phosphorus metabolism in tomato ovaries. I. Changes in phosphorus fractions. E. Marré, F. G. Teubner, and A. E. Murneek (*Amer. J. Bot.*, 1954, **41,** 722—726).—Small but significant differences in initial and subsequent growth were observed for ovaries stimulated by application of ethyl indolylacetate (in lanolin) in comparison with pollinated ovaries. During the first two days, protein synthesis was $\propto$ increases in fresh wt., but after the third day water-uptake predominated. Hexose-phosphate concn. increased in proportion to the current growth-rates of the stimulated ovaries, but decreased in the non-stimulated controls. Similar relationships were found with respect to the ratio org. to inorg. P and for acid-insol. P. P. S. ARUP.

Absorption and hydrolysis of urea by detached citrus leaves immersed in urea solutions. J. R. Kuykendall (*51st Ann. Mtg Amer. Soc. hort. Sci., Florida*, 1954, 37).—Leaves of several species of citrus absorb relatively large amounts of urea from foliar applications. Doubling the urea concentration of the solution doubled the rate of urea absorption by detached leaves. Valencia orange leaves absorbed urea faster than did Eureka lemon leaves, and young leaves absorbed urea much faster than did mature leaves. There were variety and species and age-of-leaf differences in the activity of urease in the leaves. The extractable urease activity of young leaf tissue was at least twice that of mature leaf tissue. The amount of urease activity in intact leaves was similar to that in leaf extracts. Half or more of the absorbed urea was hydrolysed within 24 hours by intact but detached leaves. Sufficient urease activity was present to indicate that urea hydrolysis is never a limiting factor in the assimilation of foliar applied urea. Sugar sprays had no effect on urease activity. L. G. G. WARNE.

Effect of urea sprays on leaf nitrogen and growth of Elberta peach. J. W. Eckert and N. F. Childers (*Proc. Amer. Soc. hort. Sci.*, 1954, **63,** 19—22).—Urea sprays (10—100 lb. per 100 gal.) applied to dormant peach trees in sand culture had no effect on subsequent growth or leaf-N. N was absorbed from foliar sprays.
L. G. G. WARNE.

Effects of urea sprays on peach. R. A. Norton and N. F. Childers (*Proc. Amer. Soc. hort. Sci.*, 1954, **63,** 23—31).—N was absorbed from foliar urea sprays. Additions of starch, molasses, or sulphur–bentonite to the sprays did not increase growth but the addition of molasses allowed a greater concn. of urea to be employed without injury. Almonds were more sensitive than peaches to leaf damage whilst apples appear to utilise N from urea sprays as easily as N supplied in nutrient solution. L. G. G. WARNE.

Nitrogen metabolism in relation to chlorosis of blueberries. C. J. Cain and R. W. Holley (*51st Ann. Mtg Amer. Soc. hort. Sci., Florida*, 1954, 35).—Amino-acids, especially arginine, accumulate in chlorotic tissue. These disappear almost completely with greening of the leaves concurrent with increased concn. of protein and chlorophyll.
L. G. G. WARNE.

Effect of differential nitrogen, potassium, and magnesium supply to young Valencia oranges in sand culture on mineral composition, especially of leaves and fibrous roots. P. F. Smith, W. Reuther, A. W. Specht, and G. Hrnciar (*Plant Physiology*, 1954, **29,** 349—355).—The N, P, K, Ca, Mg, Na, Mn, Fe, Cu, Zn, B, and Al contents of the leaf and roots of Valencia orange trees grown in sand culture with varying levels of N, K, and Mg are reported. The contents of macro-elements of the leaf were usually higher than those of the roots and usually showed the same type of variations, although there were certain exceptions, *e.g.*, increasing the K supply depressed the % of Ca in the leaf but had no effect on that in the root. The Mn, Fe, Cu, Zn, and Al contents were much higher whilst the B contents of the roots were much lower than those of the leaves. Increasing the N supply increased the % of N and Ca and reduced the % of P and K in the leaf, and increased the % of most of the trace elements in the roots. Important interactions occurred between N and both K and Mg, but not between K and Mg.
A. H. CORNFIELD.

Effect of various exchangeable cation ratios in soils on growth and chemical composition of avocado seedlings. J. P. Martin and F. T. Bingham (*Soil Sci.*, 1954, **78,** 349—360).—Avocado seedlings were grown in the greenhouse in Yolo and Hanford loam soils with variable exchangeable cation ratios. Seedlings grew best in Yolo soils containing 4 to 5% of exchangeable K and min. Na. Growth was reduced by >13% of K or >4% of Na. 14% of Na killed some seedlings and 26% killed all. Growth was not significantly different in acid, base saturated, or lime-containing soils. On the Hanford soil growth was best with 4% of exchangeable K and min. Na; 7 and 14% of exchangeable Na decreased growth by 20 and 50% respectively. In this soil the depressing effects of K and Na were additive. When the soil was diluted with sand to one third of its original exchange capacity 7% of Na did not but 14% did significantly decrease growth. The chemical composition of the seedlings was little affected by exchangeable H levels, or by excess of lime. As H levels decreased, or Ca levels increased, the Ca and Na content of the roots increased. The K content of the leaves increased as excess K symptoms (leaf burn) increased. Increased soil-Na resulted in increased leaf-K content and decreased root-K. Increased K levels decreased Ca and Mg absorption. A content of 0·2—0·5% of Na was associated with leaf burn. Roots contained more Na than did the leaves, the difference decreasing with increasing soil-Na levels. The Mn content of the plants was increased when soil-Na or K levels increased, but the reverse obtained when Ca levels increased. Leaves of seedlings in excessively limed soils contained 9 p.p.m. of Mn and showed Mn-deficiency symptoms.
T. G. MORRIS.

Responses of Florida citrus trees to nitrogen nutrition and irrigation. A. M. L. El-Tomi (*Dissert. Abstr.*, 1954, **14,** 1874).—The response of the two varieties, Satsuma and Hamlin, to differential applications of N to the soil were similar as judged by the fresh and dry wt. of the leaves on an average shoot, by the chlorophyll content of the leaves (wt. per unit area), and by the total and by the % content of N in leaves. Significant differences were observed in the Sat-

sumas, as indicated by dry wt. per leaf, and the wt. of leaves as % of fresh wt.; and in Hamlins the no. of leaves per shoot correlated with the N applied to soil. Analysis of responses to three levels of soil-N indicated that when significant differences were observed in the leaf characters, high N plots gave higher values than low N plots: there was no significant difference between the high and medium N plots. Observations were made on the leaves of the spring flush and monthly analyses were made from March until February. Chlorophyll content of Satsuma leaves was lowest in March, increased to a max. in autumn; in Hamlin leaves chlorophyll content reached an earlier max. Comparison of irrigated and non-irrigated plots failed to give values which were significantly different. E. M. J.

Relation of calcium and potassium accumulation in citrus as influenced by rootstock and salinity of irrigation water. B. S. Gorton and W. C. Cooper (*Proc. Amer. Soc. hort. Sci.*, 1954, **63**, 49—52).—The rootstock affects the contents of Ca, K, Cl, and SO_4'' in citrus leaves. An increase in the Ca content of the irrigation water increased the leaf-Ca and decreased the leaf-K. L. G. G. WARNE.

Use of soluble tissue tests in determining the mineral element status of apple trees. C. M. Ritter (*Proc. Amer. Soc. hort. Sci.*, 1954, **63**, 37—40).—Correlation between the total contents of N, P, K, Ca, and Mg in apple foliage and the amounts found in a Na acetate extract of the leaves were highly significant for P, Ca, and K in leaf blade, petiole, and entire leaf on all occasions but were rarely significant for Mg. and N. L. G. G. WARNE.

Influence of mineral nutrition on the organic acids of the tomato. A. R. Carañgal, jun., E. K. Alban, J. E. Varner, and R. C. Burrell (*Plant Physiology*, 1954, **29**, 355—360).—The contents of org. acids in various parts of the tomato plant, particularly in the fruit, at different stages of growth in relation to varying levels of N, P, and K nutrition, are reported. A. H. CORNFIELD.

Effect of temperature on the behaviour of malic acid and starch in leaves of *Bryophyllum calycinum* cultured in darkness. H. B. Vickery (*Plant Physiology*, 1954, **29**, 385—392).—When leaves of *B. calycinum* were cultured in water in the dark at 24°, the rate of disappearance of starch was inversely related to that of the formation of malic acid. Citric acid also increased slowly. At 6° all rates were somewhat less than at 24°. A. H. CORNFIELD.

Correcting magnesium deficiency in cultivated blueberries and its effect on leaf potassium, calcium, and nitrogen. J. S. Bailey and M. Drake (*Proc. Amer. Soc. hort. Sci.*, 1954, **63**, 95—100).—$MgSO_4$ to give 25—150 lb. of MgO per acre and dolomitic limestone to give 100—600 lb. per acre of MgO were applied to Mg-deficient blueberries. The lowest application of $MgSO_4$ or 200 lb. MgO as dolomitic limestone almost cured the Mg deficiency symptoms. All treatments increased the Mg content of the leaves and none affected the contents of N, K, or Ca. On this soil (pH 4) none of the treatments caused chlorosis. L. G. G. WARNE.

Availability of magnesium from organic carriers in artificial substrates. S. Dunn and S. S. Roberts (*Plant Physiology*, 1954, **29**, 337—342).—Growth of apple seedlings and maize in water and sand cultures was better when Mg was supplied as AcO′, HCO′, phthalate, malate, lactate, fumarate, or NH_4PO_4'' than as SO_4''. Thiocyanate and salicylate were toxic whilst 14 other Mg salts of org. compounds were no better than the SO_4''. A. H. CORNFIELD.

Relationship between total iron content and chlorophyll content of citrus leaf tissue. J. R. Kuykendall (51*st Ann. Mtg Amer. Soc. hort. Sci., Florida*, 1954, 36).—Citrus leaves from Fe-deficient trees were separated into groups representing four degrees of chlorosis; green, mild, moderate, and severe. A close relationship was found between the degree of chlorosis and the Fe and chlorophyll contents. No close relationship was found between Fe content and chlorophyll content in non-chlorotic citrus leaves. L. G. G. WARNE.

Effect of iron chelate on root development of citrus. H. W. Ford, I. Stewart, and C. D. Leonard (*Proc. Amer. Soc. hort. Sci.*, 1954, **63**, 81—87).—When iron chelated with ethylenediaminetetra-acetic acid was applied to soil bearing chlorotic citrus trees, increased root growth occurred. In six months "feeder" roots (1·5 mm. diam. or less) in the top 5 ft. of soil increased by 80% (fresh weight). L. G. G. WARNE.

Influence of zinc on *Silene inflata*, Smith. I. W. Baumeister (*Ber. dtsch. bot. Ges.*, 1954, **67**, 205—213).—Plants of *S. inflata* growing naturally on soil with an abnormally high Zn content differ from plants growing on normal soil in not only tolerating, but in being able to utilise to advantage (as shown by assimilation measurements), Zn in abnormally high concn. The "Zn form" differs from the normal form in being procumbent and in having smaller and narrower leaves. P. S. ARUP.

Promotion by zinc of the formation of cytochromes in *Ustilago sphærogena*. P. W. Grimm and P. J. Allen (*Plant Physiology*, 1954, **29**, 369—377).—The presence of Zn in yeast extract media was responsible for high cytochrome production by *Ustilago sphærogena*. Fe, Cu, or Mn could not replace Zn in this function. Pigment formation required a much higher level of Zn than did optimal growth. Thiamine was not an essential growth factor but its addition increased cytochrome formation in the presence of 1 p.p.m. Zn. A. H. CORNFIELD.

Absorption and translocation of radiostrontium by the leaves, fruits, and roots of certain vegetable plants. D. C. Martin (*Dissert. Abstr.*, 1954, **14**, 1875).—Tomato, beet, and bean plants were used in sand culture to study both root and foliage absorption of radio-Sr, -Ca, and -Ba, owing to the relatively large amount of Sr present in U fission products. The spectrograph and the flame spectrophotometer were used to determine Sr, Ca, K, Mg, P, B, Fe, Mn, and Cu in plant tissues, and autoradiography and radioactive sample counting were the isotope techniques used. The results are discussed: *e.g.*, radio-Ca, -Sr, -Ba are absorbed by tomato and beet roots and translocated to all above-ground plant parts; tomato plants, high in Ca, always absorbed more Sr from a root application than those low in Ca when the applied Sr was in ionic form. When the applied Sr was chelated, absorption was greater in tomato plants low in Ca. Radiostrontium penetrated the intact skin of a tomato fruit and accumulated in the inner tissues. E. M. J.

The keto-acids of plants: their identity, analysis, and metabolic rôles. G. H. N. Towers (*Dissert. Abstr.*, 1954, **14**, 1903).—A method is described which depends on the fixation of the keto-acids in the form of their hydrazones and the conversion of the isolated, purified hydrazones to amino-acids by hydrogenolysis using Pt oxide as catalyst. The amino-acids are separated by chromatography and quantitatively determined. Using this procedure which was critically examined, pyruvic, oxaloacetic, and α-keto-glutaric acids were found. Glyoxylic acid was commonly present in green leaves, roots, bulbs, and tubers. In tulip tissues a hitherto unidentified keto-acid was isolated as its 2:4-dinitrophenylhydrazone and identified as α-keto-γ-methyleneglutaric acid. Variations in keto-acid content in response to environmental change are discussed. The general level of keto-acids in tissue explants is markedly increased in presence of coconut milk growth factors. Available literature is discussed. E. M. J.

Significance of growth regulators in agricultural practice. E. J Kraus (*Proc. Amer. Soc. hort. Sci.*, 1954, **63**, 529—546).—A review. L. G. G. WARNE.

Pyridoxine as a growth factor for excised tomato roots. W. G. Boll (*Plant Physiology*, 1954, **29**, 325—331).—The clone of tomato roots required thiamine + pyridoxine + niacin for optimal growth in the basal medium (inorg. salts + sucrose) although thiamine + pyridoxine addition alone could maintain growth. Pyridoxine was replaceable by pyridoxal or pyridoxamine and in part by glycine. Niacin was replaceable by niacinamide. A. H. CORNFIELD.

Oxidation of indol-3-ylacetic acid by waxpod bean root sap and peroxidase systems. R. H. Kenten (*Biochem. J.*, 1955, **59**, 110—121).—Oxidation of indol-3-ylacetic acid by O_2 is catalysed by very pure horse-radish peroxidase prep. The rate of oxidation is increased in presence of various active factors, some of which are peroxide substrates. The indol-3-ylacetic acid oxidase of waxpod bean root-sap consists of a thermolabile fraction, a peroxidase which can be replaced by horse-radish peroxidase, and a thermostable fraction, activity of which depends mainly on presence of peroxidase substrates. Oxidation of the acid, when catalysed by horse-radish peroxidase in absence or presence of waxpod bean root thermostable factor utilises one mol. of O_2 per mol. of acid oxidised, and 1 mol. of CO_2 is formed. J. N. ASHLEY.

Interdependence of growth-substances and inhibitors in correlated bud-inhibition. I. E. Libbert (*Planta*, 1954, **44**, 286—318).—The efficient concn. of 2-indolylacetic acid (IAA) and of coumarin for the (reversible) inhibition of budding of pea shoots in aq. 2% glucose sand cultures are determined. The presence of cotyledons or of roots on the shoots promotes budding, but the effects due to IAA are unaltered in the former, and enhanced in the latter case. The addition of 10^{-8}—10^{-7} g. per ml. of coumarin greatly enhances the sensitivity of shoots with or without cotyledons to IAA, but not that of shoots with roots. A neutral germination-inhibiting substance, probably originating in the roots, can be extracted by means of ether from the pea shoots and roots. Removal of the growing-point, apart from producing an acid germination inhibitor, due to wounding, causes a reduction in the concn. of the neutral inhibitor. The latter is probably an unsaturated lactone (or activated deriv. thereof), and identical with Snow's hypothetical inhibition factor, the production or activation of which is correlated with the presence

of growth-substances. The development of axillary shoots is dependent on their endogenous vitality which decreases with age. (59 references.) P. S. ARUP.

Inducing rooting with growth-substances on Arabian jasmine (*Jasminum sambac*). S. E. Hakim (*Proc. Amer. Soc. hort. Sci.*, 1954, **63**, 469—472).—Cuttings treated with aq. indolylacetic acid (25 p.p.m.) for 24 hours before planting rooted satisfactorily. L. G. G. WARNE.

Determination of 2 : 4-dichlorophenoxyacetic acid, 2 : 4 : 5-trichlorophenoxyacetic acid, 2-methyl-4-chlorophenoxyacetic acid, and 4-chlorophenoxyacetic acid in technical mixtures by isotope dilution analysis. P. Sorensen (*Anal. Chem.*, 1954, **26**, 1581—1586).—Radioactive 2 : 4-dichloro- (**I**), 2 : 4 : 5-trichloro- (**II**), 2-methyl-4-chloro- (**III**) and 4-chloro-phenoxyacetic acid (**IV**) were prepared using radioactive ^{36}Cl and used for the isotope dilution procedures described. Methods for the determination of **I** alone, **I** and **II** together, **II** alone, **III** alone, and **IV** alone are given. The standard deviation for the determination of **I** in the presence of **II** is within $\sim\pm1\%$ and in other cases it is $\sim1\%$. The methods were applied successfully to the analysis of technical samples and agricultural preparations. G. P. COOK.

Evaluation of halogen-substituted phenoxyacetic acid and other growth-regulators in rooting of *Rhododendron* and *Ilex*. J. S. Wells and P. C. Marth (*Proc. Amer. Soc. hort. Sci.*, 1954, **63**, 465—468).—2 : 4 : 5-Trichlorophenoxyacetic and α-2 : 4 : 5-trichlorophenoxypropionic acids were most successful in inducing rooting of rhododendron and holly cuttings. Many other compounds were partially successful but β-indolylbutyric, β-naphthoxyacetic, *p*-chlorophenoxyacetic, and pentachlorophenoxyacetic acids, and α-naphthylacetamide, naphthylacethydrazide, and 2-methylnaphthylacethydrazide were ineffective. L. G. G. WARNE.

Chemical control of the flowering of *Chrysanthemum morifolium*. I. Auxin and flowering. S. Asen and R. Lindstrom (51*st Ann. Mtg Amer. Soc. hort. Sci., Florida*, 1954, 32).—The formation of flower buds on *Chrysanthemum morifolium* was effectively delayed or inhibited by daily application of indolylacetic acid. High concn. of the auxin applied less frequently did not prevent flower bud formation but did delay flowering. L. G. G. WARNE.

Effect of 2 : 4 : 5-trichlorophenoxyacetic acid on flowering and vegetative growth of Fordhook 242 bush Lima beans. P. C. Marth and R. E. Wester (*Proc. Amer. Soc. hort. Sci.*, 1954, **63**, 325—328).—Sprays of 2 : 4 : 5-T (1·5 and 3·0 p.p.m.) given early during the flowering period caused shedding of the flowers and cessation of growth for 3—4 weeks. Later, axillary shoots developed profusely and final total growth was greatly in excess of that of the control. The crop was delayed by the treatment but its amount was increased. Hand removal of early flowers similarly delayed the crop and increased its amount but did not cause an increase in total growth. Addition of minor elements to the spray caused severe stunting with very slow recovery with 3·0 p.p.m. of growth substance. L. G. G. WARNE.

Responses of the Royal apricot to 2 : 4-dichlorophenoxyacetic acid application. J. C. Crane (*Proc. Amer. Soc. hort. Sci.*, 1954, **63**, 189—193).—Sprays of aq. 2 : 4-D (50—200 p.p.m.) given at about the stage of " pit hardening " increased the rate of growth of the fruit. The increase was due to greater growth of the flesh of the fruit but embryo growth was also stimulated. The tips of young shoots were killed by the sprays. L. G. G. WARNE.

Effect of preharvest sprays of 2 : 4 : 5-trichlorophenoxyacetic acid and maleic hydrazide on certain peach varieties. P. L. Hawthorne, L. G. Jones, J. C. Taylor, and W. A. Sistrunk (51*st Ann. Mtg Amer. Soc. hort. Sci., Florida*, 1954, 41).—Three concn. of a mixture of 2 : 4 : 5-trichlorophenoxyacetic (2,4,5-T) and maleic hydrazide and two concn. of maleic hydrazide alone were applied to two varieties of peaches. Thirty p.p.m. of 2,4,5-T combined with 400 and 600 p.p.m. of maleic hydrazide applied about 28 days before harvest hastened the maturity by four or five days. The treated fruits ripened uniformly and were well coloured. Maleic hydrazide (600 and 1000 p.p.m.) applied 28 days before harvest retarded maturity by about four days, but when these treatments were applied ten days before maturity the harvest dates were not affected. When maleic hydrazide was used independently or in combination with 2,4,5-T, the treated fruits were firmer and matured more uniformly than those of the check or 2,4,5-T alone. L. G. G. WARNE.

Colour changes in skin and flesh of stored McIntosh apples sprayed with 2 : 4 : 5-trichlorophenoxypropionic acid. B. J. E. Teskey and F. J. Francis (*Proc. Amer. Soc. hort. Sci.*, 1954, **63**, 220—224).—Preharvest sprays of aq. 2 : 4 : 5-trichlorophenoxypropionic acid (20 p.p.m.) gave fruit redder and softer than that from unsprayed trees but the rate of change of skin colour in storage was the same in both groups. The sprayed fruit had, after storage, yellower flesh than the unsprayed. L. G. G. WARNE.

Storage notes on behaviour of McIntosh apples treated with various preharvest sprays. P. A. Poapst, W. R. Phillips, and S. H. Nelson (51*st Ann. Mtg Amer. Soc. hort. Sci., Florida*, 1954, 42).—The application of a spray of 2 : 4 : 5-trichlorophenoxyacetic acid produced a tendency to increased colour, lower acid content, and increased rate of softening. Maleic hydrazide applied separately and jointly with 2 : 4 : 5-trichlorophenoxypropionic acid at a concn. of 200 p.p.m. and 200 to 20 p.p.m., respectively, during the non-dropping season only, did not produce readily observable differences. L. G. G. WARNE.

Effects of *p*-chlorophenoxyacetic acid and β-naphthoxyacetic acid on increasing fruit size in thornless evergreen blackberries. Q. B. Zelinski, R. Garren, jun., and C. J. Annen (*Proc. Amer. Soc. hort. Sci.*, 1954, **63**, 182—188).—Aq. sprays of these growth substances (50 or 100 p.p.m.) given approx. 14 days after pollination increased fruit size by up to 20%. Additional later sprays gave a further increase. Receptacle size, pericarp development, and the no. of drupelets per fruit were all increased by the treatment. L. G. G. WARNE.

Effect of β-naphthoxyacetic acid on strawberry fruit. R. G. Mercier and John F. Brown (51*st Ann. Mtg Amer. Soc. hort. Sci., Florida*, 1954, 43).—β-Naphthoxyacetic acid at 50 p.p.m. was applied to three strawberry varieties at 5—25 days after anthesis in single and double applications, 5 days apart. Total yield in vol. is consistently increased as a result of larger berry size. There is no appreciable increase in total no. of berries harvested and no increase in wt. (fresh or dry) of the total crop. Treated plots initially yield fewer but larger berries. Consequently more berries, also of larger size, are picked in the latter part of the season. The growth regulator probably increases size by delaying maturity. L. G. G. WARNE.

Thinning grapes with chemical sprays. R. J. Weaver (*Proc. Amer. Soc. hort. Sci.*, 1954, **63**, 194—200).—Seventeen growth regulators were tested. Although some showed satisfactory thinning of clusters, over- or under-thinning of individual clusters was frequent because of the compact nature of the inflorescences. Reduction of cluster no. with sprays of aq. Na monochloroacetate (0·5%) and NH_4 dinitro-*o*-*sec*.-butylphenoxide (0·04%) was achieved but drift of the spray on to clusters intended to be left makes the method less reliable than hand thinning. L. G. G. WARNE.

Response of certain varieties of *Vitis vinifera* grapes to applications of benzthiazol-2-yloxyacetic acid. J. R. Weaver (51*st Ann. Mtg Amer. Soc. hort. Sci., Florida*, 1954, 42—43).—Black Corinth vines were sprayed with benzthiazol-2-yloxyacetic acid (BTA) at concn. of 5—100 p.p.m. This growth regulator at 20 p.p.m. produced the largest berries but the wt. of crop was only about half that of girdled fruit or fruit sprayed with *p*-chlorophenoxyacetic acid (PCPA). BTA usually retarded colouring. Clusters dipped in BTA at 20 p.p.m. at full bloom, or 4, 10, or 18 days later, all developed small berries of about the same size. Clusters treated with BTA and PCPA gave clusters like those treated with PCPA alone, although some clusters contained a few small berries like those resulting from treatment with BTA. BTA strikingly retarded the maturity of Red Malaga, Tokay, Ribier, Zinfandel, and Thompson Seedless grapes, as evidenced by a decrease in total sol. solids, increase in % of acid, or decrease in coloration. L. G. G. WARNE.

Influence of nitrogen level on the rate of ripening and colour development of apples sprayed with growth-regulating substances. F. W. Southwick (*Proc. Amer. Soc. hort. Sci.*, 1954, **63**, 225—233).—Preharvest sprays of 2 : 4 : 5-trichlorophenoxypropionic acid (20 p.p.m.) hasten the rate of softening and red colour development and increase the rate of respiration of apple fruits. This effect is greatest with high-N trees. Maleic hydrazide sprays (250 or 500 p.p.m.) delay fruit softening during storage and reduce the respiration rate and this effect is greater with trees at a moderate than with those at a high N level of nutrition. L. G. G. WARNE.

Control of top growth of prepackaged radishes. D. H. Dewey and S. H. Wittwer (51*st Ann. Mtg Amer. Soc. hort. Sci., Florida*, 1954, 30).—Prepackaged radishes frequently develop top growth during the marketing period when the tops are not clipped close to the roots. Practical reduction of new post-harvest top growth was attained by preharvest foliage sprays of maleic hydrazide. Applications (2500 p.p.m.) at the rate of 7½ lb. per acre 12, 24, and 48 hours prior to harvest usually gave good control of both top and growth. High field temp. between spraying and harvest and advanced maturity of the radishes tended to reduce the effectiveness of the chemical. L. G. G. WARNE.

Parthenocarpy in holly. C. H. Connors (*Proc. Amer. Soc. hort. Sci.*, 1954, **63**, 453—456).—*Ilex aquifolium*, *I. cornuta*, *I. pernyi*, *I. vomitoria*, *I. cassine*. *I. attenuata*, and *I. myrtifolia* all exhibit a

tendency to produce berries parthenocarpically and this is greatly increased by aq. sprays of 2 : 4-D (25 p.p.m.). L. G. G. WARNE.

Use of 4-phthalimido-2 : 6-dimethylpyrimidine as a plant-growth regulator. P. Rood and C. L. Hamner (*Proc. Amer. Soc. hort. Sci.*, 1954, **63**, 495—500).—Aq. sprays of this substance (100—250 p.p.m.) will induce production of parthenocarpic fruit in tomato. Sprays of 1000 p.p.m. caused no harmful effects. It also will accelerate the rooting of cuttings but at 50 p.p.m. reduces the growth rate of cucumber roots and at 10 p.p.m. the growth of wheat roots. Sprays of 1000 p.p.m. induce epinasty and other morphological effects in bean plants. L. G. G. WARNE.

Parthenocarpy in the tomato. S. P. Johnson and W. C. Hall (*Proc. Amer. Soc. hort. Sci.*, 1954, **63**, 329—332).—Hormone sprays are commonly used either as an adjunct to or a substitute for pollination in tomatoes and in the latter case give parthenocarpic fruits. Nine varieties tested all produced some parthenocarpic fruits without hormone treatment but only at high temp. (31° and over, and 35° for the variety 1388). L. G. G. WARNE.

Preharvest drop, size, and maturity of apricots as affected by 2 : 4 : 5-trichlorophenoxyacetic acid. C. J. Crane (*51st Ann. Mtg Amer. Soc. hort. Sci., Florida*, 1954, 41—42).—The drop of apricots begins with pit hardening and extends to the time of fruit maturity and may be associated with embryo abortion. A spray application of 2 : 4 : 5-T (25—100 p.p.m.) at the initiation of pit hardening effectively controlled fruit drop in both varieties. An application 98 days before harvest (initiation of pit hardening) was more effective than one made 59 days before harvest. In addition to the control of preharvest drop, fruit size and/or fresh wt. was increased and maturity hastened. L. G. G. WARNE.

Effects of "stop drop" auxins and respiratory inhibitors on the maturity of apples. R. M. Smock, L. J. Edgerton, and M. B. Hoffman (*Proc. Amer. Soc. hort. Sci.*, 1954, **63**, 211—219).—Aq. sprays of growth substances given to prevent preharvest drop of apples hasten fruit maturity, advancing the picking date by as much as ten days. Aq. maleic hydrazide sprays (50—200 p.p.m.) alone or together with growth substances delay the picking date by three to four days. A similar effect is produced by sprays of malonic acid (50—200 p.p.m.) and iodoacetic acid (100 p.p.m.). L. G. G. WARNE.

Herbicidal activity. Relation between molecular structure and physiological activity of plant-growth regulators. II. Formative activity of phenoxyacetic acids. R. L. Weintraub, James W. Brown, and J. A. Throne (*J. Agric. Food Chem.*, 1954, **2**, 996—999).—Using a bean leaf repression technique the formative activities of about 145 ring-substituted phenoxyacetic acids are reported. Halogen substitution at position 4 is necessary for high herbicidal activity; Cl is the most effective halogen, followed in order by F, Br, and I. Further introduction of Cl or Me at position 2 enhances activity, but other halogens at this position weakens activity. S. C. JOLLY.

Relative herbicidal and growth-modifying activity of several esters of *N*-(3-chlorophenyl)carbamic acid. D. K. George, W. P. Brian, D. H. Moore, and J. A. Garman (*J. Agric. Food Chem.*, 1954, **2**, 990—995).—The chemical and physical properties, together with preliminary screening evaluation of the herbicidal and plant-growth-regulating activities of a series of esters analogous to the commercial herbicide, *iso*propyl *N*-(3-chlorophenyl)carbamate (CIPC) are reported. Relatively minor changes in the alkyl group can markedly affect and even change herbicidal activity. S. C. JOLLY.

Effect of herbicides on Gladiolus flower, corm and cormel production. Le-Roy Holm and G. E. Beck (*Proc. Amer. Soc. hort. Sci.*, 1954, **63**, 447—452).—2 : 4-Dichlorophenoxyacetic acid (2 or 4 lb. per acre) (**I**), dinitro-*o*-*sec*.-butylphenol (6 lb. per acre) (**II**), 2 : 4-dichlorophenoxyethyl sulphate (3 or 6 lb. per acre) (**III**), trichloroacetic acid (15 or 20 lb. per acre) (**IV**) alone or with pentachlorophenol (4 to 6 lb. per acre) (**V**), and 3 : 6-*endo*-oxohexahydrophthalic acid (8 lb. per acre) (**VI**) were applied to gladioli plots about nine days after planting. **IV** at 20 lb. per acre reduced early flower, corm and cormel production but did not affect the final total yield of spikes. None of the other treatments had any adverse effects. **I** and **II** gave good, and **IV** alone or with **V** fair, control of broad-leaved weeds and **II**, **IV**, **IV** + **V**, and **VI** good control of grasses. Later tests with 3-(*p*-chlorophenyl)-1 : 1-dimethylurea (2 or 4 lb. per acre) (**VII**) and *iso*propyl *N*-(3-chlorophenyl)carbamate (4 or 8 lb. per acre) showed that these also controlled broad-leaved and grass weeds and did not damage the crop except that **VII** reduced cormel production. **III** gave no control of weeds but in spite of this the yield was not reduced. Unweeded plots gave the same yield as controls (hand weeded). L. G. G. WARNE.

Effect of 2 : 4-D treatment of oats on the succeeding crop. I. J. Johnson (*Agron. J.*, 1954, **46**, 475—476).—The greatest reductions in yields of grain from the progenies of plants treated with 2 : 4-D (1 lb. acid equiv. per acre) occurred where the treatments had caused the greatest yield reductions of grain. Yield reductions were correlated with reduced seed wt. and germination. Yields were similar with seed obtained from the main culm and that from the first tiller. A. H. CORNFIELD.

Effect of 2 : 4-dichlorophenoxyacetic acid on the hydrocyanic acid and nitrate content of Sudan grass. C. R. Swanson and W. C. Shaw (*Agron. J.*, 1954, **46**, 418—421).—In greenhouse tests the application of 2 : 4-D (4 lb. acid equiv. per acre) eight days previously markedly reduced the HCN content of, but had no effect on the NO_3' content of, Sudan grass. In the field the HCN content was first depressed by the treatment but then increased rapidly four days after treatment to values exceeding those of the control. The NO_3' content first increased and then decreased in comparison with the control. A. H. CORNFIELD.

Retention and effect of 2 : 4-dichlorophenoxyacetic acid sprays on winter wheat. H. D. Woofter and C. A. Lamb (*Agron. J.*, 1954, **46**, 299—302).—Average retention of 2 : 4-D sprays by winter wheat ranged from 25% to 95% depending on various factors. Retention % increased with age of plant up to the late boot stage. Greatest yield reductions occurred with application made at the early heading stage. Retention was less with large than with small spray vol. at all stages of growth, but yields were not affected by vol. of spray. The % retention was similar for all rates of 2 : 4-D. Of the types of 2 : 4-D prep. tested the *iso*propyl ester and triethanolamine salt gave the best retention. Although there were varietal yield differences in response to 2 : 4-D, these differences could not be attributed to differences in retention. A. H. CORNFIELD.

Effects of sodium 2 : 4-dichlorophenoxyethyl sulphate on annuals and perennials. C. A. Bing (*51st Ann. Mtg Amer. Soc. hort. Sci., Florida*, 1954, 32).—Many plants such as gladiolus, carnations, chrysanthemum, lilies, and most woody plants are quite tolerant to 3 lb. per acre of this herbicide, while azaleas, asters, calendulas, and foxgloves have been markedly injured. L. G. G. WARNE.

Plant metabolism. IV. Comparative effects of 2 : 4-dichlorophenoxyacetic acid and other plant-growth regulators on phosphorus metabolism in bean plants. S. C. Fang and J. S. Butts (*Plant Physiology*, 1954, **29**, 365—368).—Translocation of P (from radioactive P supplied to the roots) to bean leaves decreased with increasing applications of 2 : 4-D to the leaves. The P uptake of stem and roots was unaffected by the treatments. Treatments with 2 : 4-D, indolyl-acetic and -butyric acids, and naphthylacetic acid modified the distribution and accumulation of P in the plants and affected the incorporation of ^{32}P into some P intermediates. A. H. CORNFIELD.

Residues in crops receiving pre-emergence treatment with *iso*propyl *N*-(3-chlorophenyl)carbamate. L. N. Gard, B. O. Pray, and N. G. Rudd (*J. Agric. Food Chem.*, 1954, **2**, 1174—1176).—Food crops (head lettuce, spinach, sugar beets, onions, cotton seeds, and groundnuts) receiving pre-emergence treatment with the herbicide at rates of 2·5—8·0 lb. per acre contain <0·05 p.p.m. of *iso*propyl *N*-(3-chlorophenyl)carbamate, which is the lowest limit of sensitivity of the method of Gard and Rudd (*ibid.*, 1953, **1**, 630). S. C. JOLLY.

Autumn applications of IPC and CIPC for killing wild oats (*Avena fatua*) prior to sowing oats. A. F. Wiese and R. S. Dunham (*Agron. J.*, 1954, **46**, 358—360).—Wild oats were controlled to a practicable extent by autumn applications of *iso*propyl *N*-phenylcarbamate and *iso*propyl *N*-(3-chlorophenyl)carbamate only when the application rate was so high (15 lb. per acre) that residues were toxic to oats sown in the following spring. A. H. CORNFIELD.

Translocation path and place of action of 3-(4-chlorophenyl)-1 : 1-dimethylurea (CMU) in bean and tomato. W. H. Minshall (*Canad. J. Bot.*, 1954, **32**, 795—798).—Except for an initial time lag, a graded concn. series of aq. CMU produced similar effects on intact plants and on excised tops of tomato and kidney bean. When the material was applied to roots it was quickly carried in the xylem to the tops. A lethal concn. of CMU killed the leaf tissues, but the root lived for some days longer, indicating that the foremost toxic action took place in the leaves. R. H. HURST.

Controlling sagebrush on waste lands. J. F. Pechanec, George Stewart, A. P. Plummer, Joseph H. Robertson, and A. C. Hull, jun. (*U.S. Dep. Agric., Fmrs Bull.*, No. 2072, 36 pp.).—Methods of control, *e.g.*, planned burning (the dangers of which are emphasised), ploughing, discing, railing, harrowing, beating, grubbing, and spraying with herbicides are discussed. Regression after sagebrush control is also dealt with. L. G. L. UNSTEAD-JOSS.

Biological control of Crofton weed with the stem gall fly. Anon. (*Agric. Gaz. N.S.W.*, 1954, **65**, 61, 109).—Encouraging results have

been obtained in the biological control of Crofton weed (*Eupatorium adenophorum*) by the stem gall fly. Vigour and flowering of infected plants have been reduced although it is not yet certain whether the gall fly will kill the weed. Weakened plants should be cleared and the soil planted to grass as soon as possible.
A. H. CORNFIELD.

Effect of nitrogen fertilisation on yield, culm number, and protein content of spring wheat varieties. F. H. McNeal and D. J. Davis (*Agron. J.*, 1954, **46,** 375—378).—Application of N (50—100 lb. per acre) hastened the heading date of nine varieties of spring wheat by 1—4 days. The treatments increased culm no. and grain yields of all varieties approx. in proportion to the amount of N applied. The % increases in grain yields were greater than were the corresponding increases in culm no. The % of protein in central and lateral kernels, middle and top spikelets, and main and tiller heads are recorded. A. H. CORNFIELD.

Inheritance of winter hardiness and growth habit in crosses of selected varieties of oats. M. C. Amirshahi (*Dissert. Abstr.*, 1954, **14,** 1490).—A standard artificial freezing technique was developed. Ten varieties of winter oats of known hardiness and two spring oats were used. Details of the artificial freezing tests are described: the degree of low temp., length of exposure to cold, and the moisture condition of the soil were the most critical factors affecting the cold resistance of the seedlings. Crosses were made between winter varieties of oats and Wintok, a winter oat, and between eight winter and two spring oats. From survival data obtained for F_3, F_2, and parents, phenotypical, heredital, and environmental variances were estimated. A minimum of one gene pair differentiated winter oats from Wintok, and from two to ten pairs of genes differentiated winter from spring oats. It was concluded that cold resistance is a quantitative character governed by multiple factors, and that it is possible to combine factors for cold resistance of winter and spring oats to form more hardy strains of winter oats. Growth habit was measured by two criteria: no. of days from planting to heading, and growth type of plants. No significant correlation was observed between days to heading and cold resistance, nor between growth type and % survival. E. M. J.

Lodging resistance in oats. J. E. Grafius and H. M. Brown (*Agron. J.*, 1954, **46,** 414—418).—A mathematical treatment of the problem of lodging in young oats. Lodging, lodging resistance, and culm stiffness are defined in terms of response and resistance to applied torque. There was a significant negative correlation between degree of lodging and the lodging resistance factor.
A. H. CORNFIELD.

Relationship of top and root growth of oats. R. L. Thurman and P. Grissom (*Agron. J.*, 1954, **46,** 474—475).—In pot tests the amount of re-growth of tops and the total growth of roots of oats following clipping was much less when low than when high clipping was practised. In the field unclipped plants produced higher hay and grain yields than did plants clipped to 2·5 in.
A. H. CORNFIELD.

Vegetable rotation studies in Connecticut. III. Effect of sweet maize and vetch on growth of several crops which follow. B. Janes (51*st Ann. Mtg Amer. Soc. hort. Sci., Florida*, 1954, 38).—Lettuce and onions planted the year after a summer crop of sweet maize and a winter cover of vetch were injured while the growth of beets was stimulated. The injury to lettuce and onion was due, probably largely, to maize and under some conditions vetch might be detrimental. The growth of beets was unaffected by maize but was stimulated by vetch. L. G. G. WARNE.

Relationships of copper, indolylacetic acid, and ascorbic oxidase activity in meristematic and non-meristematic tissues of the maize plant. R. H. Maier (*Dissert. Abstr.*, 1954, **14,** 1492).—Four lines of maize with varied protein content in the grain were studied. The nodes contained the highest concn. of Cu and this had a direct relationship to the % protein in the grain. Tissues undergoing cell enlargement predominantly were characterised by lower concn. of Cu, ascorbic oxidase, and indolylacetic acid than tissues considered mature or meristematic. Node tissue was characterised by high concn. of Cu, ascorbic oxidase, and indolylacetic acid. The concn. of these substances in unfertilised primary and secondary ears of maize in relation to the growth of the cob, and to the ability of the ovules to develop when fertilised, are discussed. E. M. J.

Potato production in the north-eastern and north-central states [of U.S.A.]. G. V. C. Houghland, R. V. Akeley, T. P. Dykstra, and W. A. Shands (*U.S. Dep. Agric., Fmrs Bull.*, No. 1958, 62 pp.).—The extent and production of the potato crop, soil prep., varieties, seed disinfection, planting, diseases and their prevention, harvesting, storage, grading and marketing, and other details necessary to ensure a good potato crop in the U.S.A., are given exhaustively.
L. G. L. UNSTEAD-JOSS.

Yields of potatoes as influenced by applications of peat and manure to a sandy loam soil. R. F. Sandsted (*Dissert. Abstr.*, 1954, **14,** 1876—1877).—A sandy loam soil was given 18 annual applications of manure, peat, and inorg. fertilisers. Of plots receiving manure only, or peat supplemented with H_3PO_4 and K, or complete (NPK) fertiliser, the last gave the best total and marketable yields. Correlation coeff. obtained between growing season temp. and total yields, and between rainfall and total yields, tended to substantiate the evidence that the N in the manure- and peat-treated plots was not as readily available for plant growth as was the inorg. N in the inorganically fertilised plots. E. M. J.

Development of virus-free stock of Green Mountain potato by treatment with Malachite green. D. O. Norris (*Aust. J. agric. Res.*, 658—663).—Technique for deriving and multiplying an aseptic clone of potato in culture solution is described. By adding Malachite green to the solution, a growing tip free from virus X was obtained. This was multiplied to give a virus-free stock of the potato. R. H. HURST.

Competition among pasture plants. II. Influence of density on flowering and seed production in annual pasture plants. C. M. Donald (*Aust. J. agric. Res.*, 1954, **5,** 585—597).—Swards of varying density of *Trifolium subterraneum*, L., and *Lolium rigidum*, Gaud., were studied. The most widely spaced plants had the greatest no. of inflorescences and seeds per plant, but they had smaller seeds and fewer seeds per inflorescence than had plants from substantially denser swards. For seed multiplication, swards of moderate density gave highest yields of seed per unit area. R. H. HURST.

Effect of soil acidity on growth of pasture plants. II. Field trial with white clover (*Trifolium repens*). A. J. McNeur (*N.Z. J. Sci. Tech.*, 1954, **36, A,** 167—175).—With a view to developing a strain of white clover specifically for acid soils, plants varying widely in genotype and phototype were grown in soils treated to produce different pH, viz. lime (pH 6·5—7·0), $CaSO_4$ (5·0—5·5), untreated control (5·0—5·5), light S (4·0—4·5), heavy S (3·0—3·5). The different types of clover all behaved similarly. Heavy S-treatment produced too great acidity to permit growth; light S-treatment reduced yields; the remaining three treatments produced similar yields, *i.e.*, acidity was not a potent factor in this range. G. HELMS.

Chemical composition of some forage grasses. I. Changes with plant maturity. T. G. Philips, J. T. Sullivan, M. E. Loughlin, and V. G. Sprague (*Agron. J.*, 1954, **46,** 361—369).—The chemical composition of eight species of forage grass at different stages of growth during the spring months when they were approaching maturity is reported. Protein, acid-sol. ash, and ether extract decreased, whilst lignin increased, with maturity up to the seed-dough stage. Crude fibre and cellulose increased up to the flowering stage in some species and in others up to the seed-dough stage. Fibre decreased in some species after the flowering stage. There were significant differences due to species with respect to a no. of the constituents. Highly significant positive correlations were found among (*a*) lignin, cellulose, and crude fibre, and among (*b*) protein, ether extract, and acid-sol. ash. Significant negative correlations were found between constituents if one belonged to group (*a*) and the other to group (*b*). Feeding value in relation to stage of growth is discussed. Reed canary, Alta fescue, and bluegrass had the highest feeding val. A. H. CORNFIELD.

Reaction of some grasses to artificial salinisation. H. W. Gausman, W. R. Cowley, and J. H. Barton (*Agron. J.*, 1954, **46,** 412—414).—The tolerance of five species of grasses to artificial salinisation ($CaCl_2$ + NaCl in equiv. amounts) of their irrigation water decreased in the order Rhodes, Coastal Bermuda, blue panicum, buffel, and Angleton. The % of N in the grasses was unaffected by the treatments. The % of P was increased in Rhodes, buffel, and blue panicum and decreased in Angleton. The % of Na was increased in Coastal Bermuda and decreased in Angleton and Rhodes. A. H. CORNFIELD.

Performance of birdsfoot trefoil alone and in competition with other species in pastures. K. S. Yawalker and A. R. Schmid (*Agron. J.*, 1954, **46,** 407—411).—Highest yields of pasturage were obtained when birdsfoot trefoil was grown in association with lucerne and bromegrass; the proportion of trefoil in this pasture was low. Trefoil–bromegrass pastures gave rather lower yields; trefoil alone gave still lower yields and suffered from weed competition. Application of PK fertiliser increased yields of pasturage and crude protein on all plots over two years. A. H. CORNFIELD.

Establishment of legumes as influenced by the rate of sowing of the oat companion crop. D. Smith, H. J. Lowe, A. M. Strommen, and G. N. Brooks (*Agron. J.*, 1954, **46,** 449—451).—The effects of four varieties of spring oats sown at different rates as a companion crop with lucerne or red clover on the establishment of the legumes

at four locations over four years was studied. Legume stands were reduced to a fair extent on light-, but not on heavy-textured soils by increasing the oats sowing rate. A much greater weed population appeared where oats were sown at a light than at a heavy rate. Weeds tended to equalise the total amounts of growth on the plots. There were no differences due to variety of oats on establishment of the legumes. A. H. CORNFIELD.

Cold resistance and chemical composition in overwintering lucerne, red clover, and sweet clover. R. J. Bula and D. Smith (*Agron. J.*, 1954, **46**, 397—401).—Cold resistance (as measured by the electrical conductivity of aq. suspensions of the roots and crowns) developed later and more slowly and reached a lower level in red clover than in lucerne or sweet clover. The date at which max. cold resistance developed varied with season and depended on the permanent freezing of the soil surface. Cold resistance was retained longer in sweet clover than in the two other species. The % of starch in the roots and crowns decreased and the % of total sugars increased with increasing cold resistance. Sweet clover had the highest level of total sugars. For each species cold hardiness at any time was correlated with the % of total available carbohydrate present. The % of total N and ash were closely correlated with the % of available carbohydrate. A. H. CORNFIELD.

Manganese deficiency in subterranean clover (*Trifolium subterraneum*, L.). A. G. Tyson (*Aust. J. agric. Res.*, 1954, **5**, 608—613).—In pot experiments, Mn deficiency in a Kangaroo Island soil severely depressed the yield of the clover. Healthy plants had Mn contents (dry basis) varying from 30 p.p.m. on slightly acid soil to over 300 p.p.m. on strongly acid soil. Plants with Mn-deficiency symptoms contained only 4—25 p.p.m. Application of 56 lb. of $MnSO_4$ per acre to the soil corrected the deficiency, increasing the Mn content of the clover to 35 p.p.m. and producing a 20-fold increase in growth. The deficiency was also observed in the field, one sample of the clover having only 9·4 p.p.m. of Mn. R. H. HURST.

Harvesting small grass and legume seed. J. K. Park (*Agric. Engng*, 1954, **35**, 562—564).—Factors affecting the losses of and damage to seed during the mechanical harvesting of fescue, lespedeza, and crimson clover are described. A. H. CORNFIELD.

Combine harvesting of small-seed legumes. P. R. Bunnelle, L. G. Jones, and J. R. Goss (*Agric. Engng*, 1954, **35**, 554—558).—Some factors affecting the performance of combines during the harvesting of small-seeded legumes are reported. A. H. CORNFIELD.

Effect of some cultural practices and size of crop on the subsequent winter hardiness of apple trees. R. O. Way (*Proc. Amer. Soc. hort. Sci.*, 1954, **63**, 163—166).—Autumn irrigation and applications of NH_4NO_3 both increased the susceptibility of apple twigs to damage by artificial freezing. Drought and autumn pruning were without effect. Shoots from trees that had born heavy crops were less hardy than those from trees which had cropped lightly. L. G. G. WARNE.

Effect of differential nitrogen fertilisation on some of the physical and chemical factors affecting the quality of Baldwin apples. J. M. Beattie (*Proc. Amer. Soc. hort. Sci.*, 1954, **63**, 1—9).—Over four years the average yield varied directly with the N supply and heavy N application given in an " off " year induced annual bearing. Low N gave small, well coloured fruit. Fruits with the highest sol. solids to acid ratio were produced in heavy crop years and this ratio was increased also by moderate N supplies. L. G. G. WARNE.

The effect of tree age, variety, and soil management system on nutrient content of apple leaves. H. F. Emmert (*51st Ann. Mtg Amer. Soc. hort. Sci., Florida*, 1954, 23).—Over 200 leaf samples from McIntosh, Delicious, Cortland, and Baldwin apple trees of different ages and grown in sod with or without mulch, were collected from orchards throughout Connecticut, and tested for various macronutrients. In almost all cases values for Baldwin and Delicious samples were > those for Cortland and McIntosh. Some of the differences or lack of differences noted for Baldwin may have been the effect of bearing, since this variety was in an " off " condition when sampled. L. G. G. WARNE.

Effect of rates of nitrogen and pruning on response in Starking and Golden Delicious apples. N. R. Benson, R. M. Bullock, and I. C. Chmelir (*51st Ann. Mtg Amer. Soc. hort. Sci., Florida*, 1954, 23—24).—In a six-year study with four rates of N application and three levels of pruning on Starking and Golden Delicious apples increased rates of N application resulted in more growth, higher leaf-N, higher yields and later harvest maturity. These effects are greater in Starking than in Golden Delicious. Size is not appreciably affected when thinning is practised. Colour appears to be a function of maturity rather than rate of N application. Production decreases with increased pruning severity, but other factors are little affected. Pruning has less effect than rate of N application.
L. G. G. WARNE.

Seasonal trends of six nutrient elements in the flesh of Winesap and Delicious apple fruits. B. L. Rogers and L. P. Batjer (*Proc. Amer. Soc. hort. Sci.*, 1954, **63**, 67—73).—Total amounts of N, B, K, Ca, P, and Mg in the fruit increase as the number of days from full bloom increases but the concn. of all these elements on a dry-weight basis decreases. L. G. G. WARNE.

Degree of dissociation of acids in Rome Beauty apples and its relation to maturation, season, and differential nitrogen levels. D. Comin and D. T. Sullivan (*Proc. Amer. Soc. hort. Sci.*, 1954, **63**, 205—210).—The ratio of g.-mol. of ionic H (calculated from the pH) to the milli-equiv. of replaceable H (calculated from the titratable acidity) is taken to indicate the degree of dissociation of the acids present. This increases with fruit maturity, and is increased by N fertilising but varies greatly from season to season. L. G. G. WARNE.

Effect of controlled root temperature on Malling apple rootstocks in water culture. H. S. Nelson and H. B. Tukey (*51st Ann. Mtg. Amer. Soc. hort. Sci., Florida*, 1954, 23).—Malling I, II, VII, IX, and XVI apple rootstocks and seedling apple rootstocks were grown in water culture (1·0 Hoagland nutrient solution) maintained at four temp. 6·7, 12·8, 18·9, and 25°. Malling II and Malling IX were adversely affected by high temp., with no plants surviving at 18·9 and 25°. Malling I showed greatest growth at 12·8°. Equal tolerance was exhibited by Malling XVI to temp. of 12·8, 18·9, and 25° while Malling VII yielded slightly greater growth at 18·9 than at 12·8 and 25°. The seedling rootstocks showed a preference for the higher temp. and yielded the greatest growth at 25°. The vigour of all rootstocks was sharply reduced at 12·8°. At temp. of 18·9 and 25° there was considerable browning and sloughing of root cortex. This was especially true with the types that preferred the lower temp. and was reduced to a min. with those rootstocks that were tolerant to the high temperatures. In all cases the roots at 6·7° were pearly white. Root systems at the higher temp. were fine and much branched, whilst at the low extreme they were thick and non-branched.
L. G. G. WARNE.

Occurrence of " stem pitting " and necrosis in some body stocks for apple trees. W. W. Smith (*Proc. Amer. Soc. hort. Sci.*, 1954, **63**, 101—113).—Virginia crab as a stock shows inconsistent incompatibilities with commercial apple varieties. This may be the result of a virus as the wood pitting etc. noted here is very similar to the virus disease " quick decline " of citrus. L. G. G. WARNE.

Chemical constituents of Victoria plums: preliminary qualitative analysis. D. Dickinson and J. H. Gawler (*J. Sci. Food Agric.*, 1954, **5**, 525—529).—The preliminary examination is reported of the constituents of Victoria plums from a no. of sources, including fruit from trees on different rootstocks. The red pigment common to all samples is cyanidin-3-monoglucoside, and obvious differences in colour are apparently due to variations in the amounts of green or brown pigments. (21 references.) S. C. JOLLY.

Soil phosphorus supply in healthy and phosphorus-deficient citrus orchards in Southern California. D. G. Aldrick and J. R. Buchanan (*Proc. Amer. Soc. hort. Sci.*, 1954, **63**, 32—36).—No correlation was found between the acid-sol. or water-sol. soil P, and the incidence of P-deficiency in citrus. L. G. G. WARNE.

Nitrogen translocation in citrus. A. Wallace and I. Z. Zidan (*51st Ann. Mtg Amer. Soc. hort. Sci., Florida*, 1954, 36).—Leaves which abscissed when nine months old returned very little N to the stem. With older leaves approx. half the N and P and one third of the K was returned to the shoots before leaf fall. Labelled (radioactive) C appeared in the leaves about four days after its application and tended to accumulate in young leaves and fruits. Ringing had little effect on the upward movement of N in the trees. N moved both upward and downward in grafted trees. L. G. G. WARNE.

Bark and bud disorders of mandarin and mandarin hybrid rootstocks in Texas citrus plantings. E. O. Olson (*Proc. Amer. Soc. hort. Sci.*, 1954, **63**, 131—136).—Of 21 varieties used as stocks for grapefruit, some trees of 14 developed cachexia in the stock. This is bud transmitted and causes stem pitting and impregnation of the phloem by gum in susceptible rootstock. L. G. G. WARNE.

Influence of rootstock and tree age on root distribution of citrus. H. W. Ford (*Proc. Amer. Soc. hort. Sci.*, 1954, **63**, 137—142).—" Feeder roots " (1·5 mm. diam. or less) may penetrate to a depth of 17 ft. but the distribution is partly dependent on the rootstock employed. Grapefruit as a stock gave feeding root systems confined to the upper 7 ft. of soil. L. G. G. WARNE.

Concentration of five nutrient elements in orange fruits collected at different stages of maturity. Z. I. Zidan and A. Wallace (*Proc. Amer. Soc. hort. Sci.*, 1954, **63**, 53—58).—The total amounts of N, P, K, Ca, and Mg per fruit increased throughout the growing period but N, P, K, and Mg, as % of dry wt., decreased regularly except for a slight increase when the fruits were nine months old. Trees given

high N dressings produced fruits low in P, Mg, and Ca and, in Washington navel but not in Valencia oranges, low in K also. L. G. G. WARNE.

Seasonal changes in dry matter and nutrient composition of bearing Valencia orange trees. S. H. Cameron, A. Wallace, and R. T. Mueller (*Proc. Amer. Soc. hort. Sci.*, 1954, **63**, 59—66).—Orange trees about 10 years old increased in dry wt. by about 20% in a year. Of this increase about a quarter was in the root, one-sixth in the foliage, and the remainder in the shoot system. From 30 to 50% of the total P, Ca, K, and Mg was contained in the leaves. L. G. G. WARNE.

Four years' results with phosphate responses by Valencia orange trees. T. W. Embleton, J. D. Kirkpatrick, and W. W. Jones (*51st Ann. Mtg Amer. Soc. hort. Sci., Florida*, 1954, 35).—Increased P uptake is associated with increases in yield (especially of top quality fruit), in sp. gr. and juiciness and a reduction in fruit size, acidity, and peel thickness. L. G. G. WARNE.

Influence of several phosphate sprays on phosphorus deficiency of Valencia orange trees. T. W. Embleton, W. W. Kirkpatrick, and W. W. Jones (*51st Ann. Mtg Amer. Soc. hort. Sci., Florida*, 1954, 35).—Soil applications of P are more effective than spray applications in correcting P-deficiency of oranges. L. G. G. WARNE.

"Creasing" of Valencia orange fruits as related to NPK fertilisation, yield, fruit quality, and ash analysis of the leaves and fruits. J. D. Kirkpatrick, T. W. Embleton, and W. W. Jones (*51st Ann. Mtg Amer. Soc. hort. Sci., Florida*, 1954, 35).—Creasing of the peel of Valencia oranges is increased by P and decreased by K and N fertilisers. Creasing increases in incidence as the no. of fruits per tree increases. Creased fruits are juicier and have a higher sp. gr., a lower acid content, and a thinner peel than have normal fruits. L. G. G. WARNE.

Effect of time of harvest on yield, size, and grade of Valencia oranges. W. W. Jones, C. B. Cree, and T. W. Embleton (*51st Ann. Mtg Amer. Soc. hort. Sci., Florida*, 1954, 37).—Delayed harvesting, besides affecting yields and quality adversely, tends to induce the "alternate" bearing habit. L. G. G. WARNE.

Seasonal changes in carbohydrates in the Marsh grapefruit tree in Arizona. G. C. Sharples and L. Burkhart (*Proc. Amer. Soc. hort. Sci.*, 1954, **63**, 74—80).—Carbohydrate reserves near the meristems were depleted when spring growth commenced. During the winter the conversion of starch to sol. compounds occurs when the temp. falls below 13°. L. G. G. WARNE.

Freezing tests with small trees and detached leaves of grapefruit. W. C. Cooper, B. S. Gorton, and S. D. Taylor (*Proc. Amer. Soc. hort. Sci.*, 1954, **63**, 167—172).—Two-year-old trees on sour orange and on mandarin rootstocks were equally susceptible to frost damage. Damage is greater in Feb. and March than in Jan. (in Texas) and detached leaves show less injury than do leaves still attached to the trees. L. G. G. WARNE.

Some physiological root characteristics in citrus and avocado. R. L. Smith and A. Wallace (*Proc. Amer. Soc. hort. Sci.*, 1954, **63**, 143—145).—Apical portions of root several cm. long were used and the different types of citrus studied showed great differences (70%) in their O_2-consumption but smaller differences in cation-exchange capacity. For two types of avocado (*Persea americana*) the differences were very small. L. G. G. WARNE.

Effects of NPK fertilisation on avocados in California. T. W. Embleton, W. W. Jones, and J. D. Kirkpatrick (*51st Ann. Mtg Amer. Soc. hort. Sci., Florida*, 1954, 38).—N failed to increase the yield of avocado fruit. P had no effect on yield in a soil in which oranges showed marked P deficiency. L. G. G. WARNE.

Rooting of Muscadine grapes under mist. R. H. Sharpe (*Proc. Amer. Soc. hort. Sci.*, 1954, **63**, 88—90).—Succulent immature shoot tips used as cuttings rooted well under continuous mist. L. G. G. WARNE.

Responses of Vinifera grapes to zinc sulphate. E. Snyder and F. N. Harmon (*Proc. Amer. Soc. hort. Sci.*, 1954, **63**, 91—94).—Aq. $ZnSO_4$ (½ lb. and 2 lb. per gal.) was applied to the pruning cuts. The more conc. solution caused some bud injury and gave a lower yield than did the dil. solution unless applied late in the winter. This was for grapes affected with "little leaf." L. G. G. WARNE.

Replanting peaches in New Jersey. L. M. Shannon and E. G. Christ (*Proc. Amer. Soc. hort. Sci.*, 1954, **63**, 151—156).—Peaches planted after peaches grow satisfactorily in New Jersey. Of various mulches tried only maize cob mulches increased growth. Minor elements (Mn, Zn, Cu, Fe, and B) applications were without effect but soil fumigation with dichloropropane–dichloropropene was beneficial. L. G. G. WARNE.

Effect of fertilisers on yield, quality, and leaf composition of figs. E. L. Proebsting and R. M. Warner (*Proc. Amer. Soc. hort. Sci.*, 1954, **63**, 10—18).—N fertilisers gave (in California) increased growth and yields without any increase in the number of defective fruits. L. G. G. WARNE.

Propagation of mango by air layering for rootstocks. L. B. Singh (*Proc. Amer. Soc. hort. Sci.*, 1954, **63**, 128—130).—Young shoots of mango can be rooted successfully by air layering if a ring of bark is removed from the base of the shoot and the wound treated with 1·0% α-naphthylacetic acid in lanolin. L. G. G. WARNE.

A rapid objective method for evaluation of colour in strawberries. W. M. Hoover and R. A. Dennison (*51st Ann. Mtg Amer. Soc. hort. Sci., Florida*, 1954, 28).—A rapid method is described for the measurement of red colour in strawberries with the Hunter Colour-Difference Meter using the "Rd" circuit. The relative colour score of berries is determined by the formula Y = antilog 0·40239/0·03125X, where X represents the "A" value of the colour meter. The formula is an expression of the response of the Hunter Colour-Difference meter to different concn. of Congo Red dye ranging from 10 to 50 p.p.m. when dispersed in a suspension of agar-agar and light MgO. L. G. G. WARNE.

Nitrogen and phosphorus relationships in the inorganic nutrition of strawberries. C. R. Smith and L. R. Bryant (*51st Ann. Mtg Amer. Soc. hort. Sci., Florida*, 1954, 34).—Results of experiments with the Gem variety of strawberries grown in sand culture with three levels of N and three levels of P in all possible combinations show that additions of P to a substrate deficient in N intensify the evidences of N-deficiency in the plants. L. G. G. WARNE.

Longevity of blueberry seed in cool storage. G. M. Darrow and D. H. Scott (*Proc. Amer. Soc. hort. Sci.*, 1954, **63**, 271).—Seed stored for 9—12 years at 4·4° showed in many cases good germination (up to 80%). L. G. G. WARNE.

Biochemical changes in cranberries during development. H. Gorfien, F. B. Chandler, and W. B. Esselen (*51st Ann. Mtg Amer. Soc. hort. Sci., Florida*, 1954, 34).—In three varieties there was a gradual increase in sol. solids and benzoic acid content as the fruit developed on the vine to maturity. The pectin content tended to decrease between the middle of July and the latter part of Aug., and then to increase until the middle of Sept., after which it showed a gradual decrease. The total acid content increased up to a point and then decreased as the fruit developed. The benzidine peroxidase activity of cranberries decreased as they matured on the vine. L. G. G. WARNE.

Genetics of heterosis for earliness in the tomato. A. B. Burdick (*Genetics*, 1954, **39**, 488—505).—Heterosis is of general occurrence in tomatoes. In flowering time, hybrids are generally intermediate between the parents but heterosis is evident in the earlier ripening of the fruit of the hybrid. L. G. G. WARNE.

Yield and grade of tomatoes as affected by frequency of irrigation and size of seedling. A. A. Kattan, K. R. Stino, and A. Attwa (*51st Ann. Mtg Amer. Soc. hort. Sci., Florida*, 1954, 25).—Yields of tomatoes increased as the size of the seedling planted out increased. Frequent irrigation increased the proportion of "culls" and especially of fruit with radial cracks. L. G. G. WARNE.

Efficiency of various methods of application of phosphorus for tomatoes. L. G. Jones and G. F. Warren (*Proc. Amer. Soc. hort. Sci.*, 1954, **63**, 309—319).—P (50 or 200 lb. per acre) placed in a band 6 in. deep, under the plants, or broad-cast and ploughed in was more effective than when given as two bands 3 in. deep on each side of the plants or broad-cast and disced in. The use of a P-containing starter solution had a beneficial effect on both early and total yields and reduced the magnitude of the effects due to fertiliser placement. High yields were associated with high early P-uptake rather than with high total P-uptake by the plants. L. G. G. WARNE.

Yields of greenhouse tomatoes as affected by various mulching materials and by soil steaming and leaching practices. I. Plant growth and yield. II. Chemical analysis of foliage. F. S. Howlett, I. C. Hoffman, E. K. Alban, and W. P. Martin (*51st Ann. Mtg Amer. Soc. hort. Sci., Florida*, 1954, 39).—I. Various mulches all increased yields and generally soil steaming and leaching were beneficial.

II. Soil steaming increased the amount of N, K, and Mn in the leaves. The mulches had variable effects on leaf K, Fe, and Mn. L. G. G. WARNE.

Environmental factors influencing vascular browning of tomato fruits. C. B. Hall and R. A. Dennison (*51st Ann. Mtg Amer. Soc. hort. Sci., Florida*, 1954, 39).—Vascular browning was found to be associated with shade, mist, soil compaction, and low night temp. L. G. G. WARNE.

Effect of maturity, apple emanations, waxing, and growth regulators on respiration and red colour development of tomato fruits. F. H. Emmert and F. W. Southwick (*Proc. Amer. Soc. hort. Sci.*, 1954, **63**, 393—401).—"Mature green" tomatoes after picking showed a

climacteric respiration peak after which the respiration rate fell. More mature fruit did not show a climacteric after picking. Mature green fruits (but not more mature ones) showed accelerated ripening due to emanations from apple fruits but aq. sprays of 2 : 4-dichlorophenoxyacetic acid (1000 or 2000 p.p.m.) did not accelerate ripening or affect respiration. Waxing the fruits reduced CO_2 output greatly, if the stem scar was sealed, whilst colour development and ripening were retarded. L. G. G. WARNE.

Effect of spacing in the row on maturity, average head size, and yields of four varieties of cabbage grown on muck soil. A. Emil Wolf (*51st Ann. Mtg Amer. Soc. hort. Sci., Florida*, 1954, 26).—Four cabbage varieties were grown in rows 28 in. apart. Plants spaced 12 in. apart matured several days in advance of those spaced 6 in. apart. The average wt. per head of the four varieties was reduced 8, 15, 11, and 15% by spacing at 6 in. and increased 26, 14, 13, and 8% by spacing 12 in. apart, as compared with the average for the four varieties at the 9-in. spacing. Yields in lb. were highest for all four varieties at the 6-in. spacing. L. G. G. WARNE.

Effect of warm storage on the bolting of onions grown from sets. W. H. Lachman and E. F. Upham (*Proc. Amer. Soc. hort. Sci.*, 1954, **63,** 342—346).—Onion sets kept at 30° for the later part of their storage period showed subsequently much less flowering than those stored at 0°. The high temp. storage gave increased yields, did not reduce bulb splitting but gave bulbs less flat than those derived from sets stored at 0°. L. G. G. WARNE.

Biochemical changes occurring in the Southern Pea *(Vigna sinensis)* at six stages of maturity. M. W. Hoover and R. A. Dennison (*Proc. Amer. Soc. hort. Sci.*, 1954, **63,** 402—408).—Samples collected at intervals from the time the seeds could be separated from the fruit until maturity indicate that development of the seed is accompanied by an increase in alcohol-insol. solids and starch and a decrease in moisture, protein, reducing sugars, and total sugars (all on a fresh-wt. basis). Of the total sugars less than one fifth was present as reducing sugar in the early stages and this value fell to almost zero at maturity. L. G. G. WARNE.

Seed variations in pea rogues. D. E. Yen (*N.Z. J. Sci. Tech.*, 1954, **36, A,** 117—121).—Wt. yields of peas from rogue and normal plants are not significantly different; but rogues produce the greater number of peas whose average wt. is therefore less than for normal lines. Inter-plant differences in respect of single seed wt. and no. of peas are less with rogues than with normal lines. Seed wt. characteristics appear to be heritable. G. HELMS.

Relation of morphological structure and development to seed coat rupture in beans *(Phaseolus vulgaris)*. H. M. Farooqui and J. P. McCollum (*Proc. Amer. Soc. hort. Sci.*, 1954, **63,** 333—341).—Varieties differ in their susceptibility to this trouble but a variety in which seed coat rupture is frequent is unsuitable for the production of dry beans. Rapid growth during seed development increases the incidence of splitting. This is so only within and not between varieties. Generally high yields are positively correlated with a high % of ruptured seeds. L. G. G. WARNE.

Yield response of beans to repeated use of soil fumigants and three sources of nitrogen. V. F. Nettles (*Proc. Amer. Soc. hort. Sci.*, 1954, **63,** 320—324).—Annual soil fumigations with dichloropropane–dichloropropene or with 41% ethylene dibromide for five years had no harmful effect on bush beans. Yields were greater when at least some of the fertiliser N was in the form of NH_4^+. This may have been the result of greater losses of N by leaching when all the N was supplied as NO_3^-. L. G. G. WARNE.

Effect of application rates of nitrogen, phosphorus, and potash on some chemical constituents in two varieties of hops. K. R. Keller and R. A. Magee (*Agron. J.*, 1954, **46,** 388—391).—Two varieties of hops in a factorial experiment with varying levels of N, P, and K showed good yield responses to N but not to P and K. The % of total soft resin, α-acid, and β-fraction in the hops are reported. Fertiliser treatments had no effect on these values for the Fuggles variety. Application of N (100 lb. per acre) decreased the % of total soft resin and α-acid, whilst K (300 lb.) increased the % of total soft resin and β-fraction in the Late Cluster variety. A. H. CORNFIELD.

Relative growth and yield of budded and seedling tung trees for the first seven years in the orchard. S. Merrill, jun., F. S. Lagasse, M. S. Neff, and W. W. Kilby (*Proc. Amer. Soc. hort. Sci.*, 1954, **63,** 119—127).—Budded trees make less growth and gave lower yields than seedling trees. The ratio of yield to cross-sectional area of the trunk was the same for the two types of trees. L. G. G. WARNE.

Response of tung trees to phosphorus and other elements on Savannah very fine sandy loam. M. Drosdoff, W. W. Kilby, and G. F. Potter (*Soil Sci.*, 1954, **78,** 361—366).—Manurial trials with tung trees are recorded. Over the last seven years of the experiment the yield of fruit was markedly affected by P treatment. Trees receiving added P gave 146% more than those dependent on soil P, the latter not only bearing less fruit but also less fruit per unit of bearing surface. K had no effect on yields initially but increased them significantly in the later years of the trials. Trees receiving Mg alone yielded more than those receiving neither Mg nor P, but trees receiving Mg and P yielded less than those receiving P alone. Significant differences were found in the response of different clones to P, K, and Mg. P treatment increased the N content of the leaves. Leaf P on plants receiving no P decreased with time, but P treatment increased leaf P to satisfactory levels. The leaf-K content was the same whether trees received P or not, but when yields were heavy there was a significant drop in leaf K on P-treated trees. K treatment significantly increased leaf-K contents: the Mg content of leaves was reduced and the N content increased by this treatment. T. G. MORRIS.

Groundnut curing as related to mechanisation. N. C. Teter (*Agric. Engng*, 1954, **35,** 568—569, 573).—Recommendations for the mechanical harvesting and curing of groundnuts are given. A. H. CORNFIELD.

Mechanisation of kenaf fibre production. H. D. Whittemore and J. B. Cocke (*Agric. Engng*, 1954, **35,** 488—491).—Machines and methods recently developed for the large-scale production and processing of kenaf are described. A. H. CORNFIELD.

Distribution of ascorbic acid and latex vessels in three tissue regions of sweet potatoes. W. F. Jenkins and E. L. Moore (*Proc. Amer. Soc. hort. Sci.*, 1954, **63,** 389—392).—In the storage roots of sweet potatoes ascorbic acid and latex vessels are both most abundant in the cambial region. L. G. G. WARNE.

Tissue activity and structural differences in the storage roots of Maryland Golden and Jersey Orange sweet potatoes as related to cracking. A. E. El-Kattan and F. C. Stark (*Proc. Amer. Soc. hort. Sci.*, 1954, **63,** 378—388).—Cracking occurs because internal tissues of the root are still expanding when the outer tissue has become inactive. Retardation of the activity of these outer tissues may result from inadequate soil moisture. L. G. G. WARNE.

Moisture content of packing medium, temperature and duration of storage as factors in forcing lily bulbs. N. W. Stuart (*Proc. Amer. Soc. hort. Sci.*, 1954, **63,** 488—494).—Lily bulbs can be forced without long storage if packed in moist peat and kept for five to six weeks at 7·2 to 10°. These temp. accelerate flowering much more than does storage at 0°. L. G. G. WARNE.

Flower removal in the field and its effects on bulb production and forcing quality of *Narcissus pseudo narcissus* var. King Alfred. E. W. Kalin (*Proc. Amer. Soc. hort. Sci.*, 1954, **63,** 473—487).—Removal of flowers only (leaving the stalk) in the field gives the largest bulbs which produce the greatest number and best quality of blooms when forced. Removal of any part of the flower stalk reduces bulb production and quality (as shown by subsequent forcing behaviour). L. G. G. WARNE.

Machine for harvesting gladiolus corms. M. G. Cropsey, R. N. Lunde, and D. E. Stafford (*Agric. Engng*, 1954, **35,** 565—567, 573).—The machine is described. A. H. CORNFIELD.

Effects of soil mulches on greenhouse roses. F. D. Widmoyer and C. H. Sherwood (*Proc. Amer. Soc. hort. Sci.*, 1954, **63,** 462—464).—Two-inch insulating mulches of maize cob, sawdust, or vermiculite increased the water-holding capacity, reduced the CO_2 content and decreased the temp. fluctuations of the soil, but did not affect growth or flowering. L. G. G. WARNE.

[**Pesticides.**] **Formulation of dry concentrates and dilute dusts.** J. F. Lesveaux, Harry West, F. S. Black, and C. C. Cassil (*J. Agric. Food Chem.*, 1954, **2,** 1022—1024).—Methods and problems associated with the production of these formulations are discussed. S. C. JOLLY.

Phytotoxicity of insecticides in mist concentrate type formulations. D. F. Clower and J. G. Matthysse (*J. econ. Ent.*, 1954, **47,** 735—738).—The relative toxicity of insecticides and acaricides to various species of woody ornamental plants was determined. Malathion, Lindane, Heptachlor, and Chlordane were the most injurious insecticides and DMC was the most phytotoxic acaricide. Isodrin, Aldrin, Dieldrin, and DDT gave the least injury, and Ovotran, Chlorobenzilate, and Compound 923 were the least phytotoxic acaricides. Addition of Sovaspray 100 as a carrier to an oil solution caused injury ≯ that by the same emulsions alone. Plants least susceptible and those highly susceptible to injury by acaricides are listed. A. A. MARSDEN.

Tomato plant absorption and translocation of manganese and zinc from dithiocarbamate fungicide sprays. R. Mollenhauer and C. B. Smith (*Proc. Amer. Soc. hort. Sci.*, 1954, **63,** 297—303).—Tomato plants sprayed with Manzate absorbed Mn, but no Zn was absorbed from sprays of Zerlate. L. G. G. WARNE.

Effect of variable rates of lead arsenate sprays on the acid content of Ruby Red grapefruit. E. J. Deszyck (*51st Ann. Mtg Amer. Soc. hort. Sci., Florida*, 1954, 37).—There is a general decrease in the % of acid during ripening. Pb arsenate applied as a post-bloom foliar spray further reduced the acid. The decrease in acid due to Pb arsenate varied with the seasons. The greatest reduction occurred during 1953—4, and the lowest, during 1951—2. Pb arsenate sprays slightly increased the percentage of combined acid of the juice, but this increase did not account for the larger loss of free acid due to the Pb arsenate treatment. L. G. G. WARNE.

Effect of sprinkler irrigation in an arid climate on the spread of bacterial diseases of beans. J. D. Menzies (*Phytopathology*, 1954, **44**, 553—556).—The effect of comparable overhead sprinkler and furrow irrigation on the spread of two artificially inoculated bacterial diseases of field and lima beans has been studied. No secondary infection was found in the furrow-irrigated plots, but with sprinkler irrigation mild secondary infection occurred late in the season in all cases. Increasing the time of sprinkling had no effect. T. G. MORRIS.

Effects of insecticides on cytochrome oxidase obtained from the American cockroach. P. E. Morrison and A. W. A. Brown (*J. econ. Ent.*, 1954, **47**, 723—730).—The effects of 26 org. insecticides on the cytochrome-*c* oxidase of muscle tissue from *Periplaneta americana* were determined *in vitro* at concn. of 10^{-3} and 10^{-5}M. Chlorinated hydrocarbon compounds inhibited the enzyme at the higher concn. and caused slight transient stimulation at 10^{-5}M. At the higher concn. inhibition was rapid for DDD, Methoxychlor, Lindane, and Toxaphene, and slower with DDT, Aldrin, Dieldrin, and the Chlordane compounds. Dinitro-compounds, DNOC, DNCHP, and DNBP, had a stimulatory effect at low concn. whilst the two latter compounds were inhibitory at 10^{-3}M. The org. phosphates, especially TEPP, stimulated at one or both concn.; only Malathion and Parathion caused complete inhibition at 10^{-3}M. Nicotine stimulated at both concn. and rotenone at 10^{-5}M. Pyrethrins and allethrin at 10^{-3}M. completely inhibited the enzyme. At the higher concn., phenothiazine, Lethane 60, and Lethane 384 markedly inhibited the oxidase. The significance of these results will depend on studies of this enzyme *in vivo* as the insect under test is progressively poisoned. A. A. MARSDEN.

Relation of the activation of Schradan in plant tissues to its toxicity to insects and mites. P. de Pietri-Tonelli and R. B. March (*J. econ. Ent.*, 1954, **47**, 902—908).—The activity of Schradan itself was compared with that of Schradan after contact with plant and animal tissues, against several insects and the citrus red mite. Schradan was toxic by contact or ingestion to nymphs of *Aphis medicaginis*, adults of *Metatetranychus citri*, and larvæ of *Culex quinquefasciatus*. No significant difference in toxicity was found between Schradan before and after exposure to the activating processes of plant (bean leaves) or animal (liver) tissues. The small amounts of active metabolite produced in plant tissues when ingested with much larger quantities of unchanged Schradan were unimportant in relation to toxicity. Unchanged Schradan was metabolised in the insect giving, amongst other compounds, an active toxic metabolite. A. A. MARSDEN.

Factors affecting the rate of penetration of DDT. C. C. Roan and F. H. Babers (*J. econ. Ent.*, 1954, **47**, 798—800).—The penetration of DDT in the American cockroach as affected by variations in the concn. and vol. of $COMe_2$ solutions, topically applied, is examined. Limiting factors in increasing the rate of penetration included the few areas of uniformly constituted exoskeleton. No DDE was recovered in these experiments. A. A. MARSDEN.

Effects of soil treatments with insecticides on plant growth and fruit quality of strawberries. G. G. Gyrisco and R. H. Burrage (*J. econ. Ent.*, 1954, **47**, 859—863).—Dusts of Aldrin, Dieldrin, Chlordane, Pb arsenate, Parathion, $C_6H_6Cl_6$, and Lindane at various concn. were used for the control of white grubs attacking strawberry plants (variety Sparkle). None of the insecticides affected the growth, vigour, or disease susceptibility of the plants, but all except Chlordane and Pb arsenate imparted off-flavours or odours to the fresh and/or processed fruit. A. A. MARSDEN.

Joint action of chlorinated terphenyl with Lindane and with allethrin. Ching-Hsi Tsao, I. Hornstein, and W. N. Sullivan (*J. econ. Ent.*, 1954, **47**, 796—798).—When tested against houseflies by the topical application method, a Lindane–chlorinated terphenyl mixture (1 : 2) was 0·8 times as toxic as was Lindane alone. An allethrin–chlorinated terphenyl mixture (1 : 1) was 1·3—1·4 times as toxic as allethrin alone. Chlorinated terphenyl reduced the initial toxicity of allethrin residues but extended its effectiveness. A. A. MARSDEN.

Adsorption of Lindane by soils. C. L. W. Swanson, F. C. Thorp, and R. B. Friend (*Soil Sci.*, 1954, **78**, 379—388).—The adsorption of Lindane by columns of various soils has been examined. Lindane in light petroleum was percolated through. The amount of Lindane held by the soil increased as the clay content increased, quartz sand held none and a silty clay loam (38% of $<2\mu$. clay) held 0·214 g. per 100 g. of oven dry material. Silica gel adsorbed 2 g. per 100 g. of material. No correlation was found between the retention of Lindane and the amount of exchangeable Ca, K, or H or the base saturation and acidity of the soils studied. A correlation similar to that obtained for the retention of Lindane and the clay content was found between exchangeable Mg and Lindane retention. Lindane was not adsorbed by either anionic or cationic exchange resins. Moisture greatly reduced the adsorption. Lindane is likely to persist longer in fine than in coarse textured soils. T. G. MORRIS.

The effects and correction of DDT phytotoxicity to cucumbers. G. B. MacCollom (*Dissert. Abstr.*, 1954, **14**, 1863—1864).—Activated charcoal added to DDT dusts, but not to DDT sprays, was effective in reducing the phytotoxicity to cucumbers, a ratio of 3 pt. of activated charcoal to 1 pt. of technical DDT giving the best results. Five weekly applications of a 2% technical DDT dust with and without activated charcoal were made to five varieties of cucumbers. The activated charcoal caused a significant increase in yield in four varieties. The impurities present in technical DDT collected as residue from the wettable powder and resuspended caused severe injury to potted cucumbers. DDT injury is primarily associated with the *op'*- and *pp'*-isomers, the *op'*-isomer being twice as phytotoxic as the *pp'*-isomer. There was in general an accumulation of NO_3'-N and a depression of Ca in the chlorotic foliage of DDT-treated plants. Results of tests indicated that activated charcoal reduces the toxic insecticidal contact effect of DDT to the pea aphid and to the southern armyworm, but not the insecticidal stomach action effect of DDT in the southern armyworm. E. M. J.

Insecticide residues on vegetable crops. C. H. Van Middelem and R. E. Waites (*51st Ann. Mtg Amer. Soc. hort. Sci., Florida*, 1954, 29).—Parathion residues seven days after application were, turnip greens 0·8—2·6, cabbage 0·3—2·1 p.p.m. Residues of Malathion one week after the last application were cabbage 2·4—8·7, turnip greens 0·8—1·1, spinach 2·2—6·2 p.p.m. Chlordane residues on lettuce, broccoli, and snap beans ranged from 0·5 to 4·0 p.p.m. seven days after treatment. After nine applications of Toxaphene on tomatoes, three harvests showed approximately 3 p.p.m. remaining after 5—7 days of weathering. Residual Systox was $<$ 0·5 p.p.m. on snap beans 20 days after application. No Systox occurred in mature beans after the seed had been soaked in 2% Systox for one hour before planting. In general, the P insecticides decomposed more rapidly than the chlorinated hydrocarbons. L. G. G. WARNE.

Use of the fruit fly *Drosophila melanogaster* as a bioassay in detecting minute quantities of benzene hexachloride [BHC] in plant tissue. R. E. Olson (*Dissert. Abstr.*, 1954, **14**, 1876).—This bioassay test was used to determine the toxicity of org. chloride material found in potatoes grown in soil treated with BHC. The production of the flies is described and cultures were used for only one generation. Solutions of pure γ-BHC from 10,000 p.p.m. to 0·01 p.p.m. in ether were used; 20 flies were introduced into a large pyrex test tube the bottom 2 in. of which had been treated with an even residue of BHC or tuber extract. The basic knockdown curve (pure BHC) showed little change in time till knockdown between 10,000 p.p.m. (2·3 min.) and 10 p.p.m. (3·6 min.) and the curve was between 10 and 0·4 p.p.m. (41·3 min.). The sensitivity of the flies in regard to size, sex, and age is discussed and also the effect of temp., humidity, and light. The toxicant was extracted from the potatoes by a triple steam-distillation process; 1 kg. of tubers gave 100 c.c. of ether extract. E. M. J.

Detergent washing for removal of insecticide residues from fresh vegetables. B. D. Thompson and C. H. Van Middelem (*51st Ann. Mtg Amer. Soc. hort. Sci., Florida*, 1954, 29—30).—Water washing alone in small-scale laboratory equipment removed up to 60% of the surface residues of Toxaphene and Parathion. Detergents removed significantly more Toxaphene than did water from all vegetables except tomatoes. Parathion residues were generally less after washing with detergents than after water washing, but the differences were not significant except in the case of mustard greens. Synthetic detergents generally resulted in greater losses in wt. of the vegetables during storage than did soap solutions or water. Dil. solutions of the synthetic detergents caused some apparent injury to green beans but to none of the other vegetables. L. G. G. WARNE.

Antibiotics in plant disease control. J. C. Dunegan (*J. Agric. Food Chem.*, 1954, **2**, 1020—1022).—Recent field tests are surveyed and the economics of this form of control are discussed. S. C. JOLLY.

Antibiotics in the systemic control of plant disease. S. H. Crowdy (*Research*, 1954, **7**, 483—486).—Methods of control of plant diseases are surveyed, and the potentialities of systemic fungicides are discussed. Laboratory-scale trials with antibiotics applied to the roots

of sand-cultured or water-cultured plants or to plant stems are described. Aureomycin applied to tomato plants was effective against gall-producing *Bacterium tumifaciens*; streptomycin in lanolin applied to the stems of field beans prevented halo blight; griseofulvin was effective against *Botrytis cinerea* on lettuce, *Alternaria solani* on tomato, and *Erysiphe graminis* on oats. The effects of some other antibiotics are given. G. HELMS.

Smog injury and rust infection. C. E. Yarwood and J. T. Middleton (*Plant Physiology*, 1954, **29**, 393—395).—Bean and sunflower leaves infected with rust were injured to a lesser extent by artificial or natural smog than were healthy leaves. Water extracts of rust-infected tissue applied to healthy plants were not effective in reducing smog damage. A. H. CORNFIELD.

Effect of fertiliser treatments on earworm damage and on yield in sweet maize. H. W. Gausman and G. P. Wene (*Proc. Amer. Soc. hort. Sci.*, 1954, **63**, 304—308).—P decreased and N increased the amount of earworm damage. Yield responses to N were erratic. L. G. G. WARNE.

Microdetermination of the acaricide ethyl *pp'*-dichlorobenzilate (Chlorobenzilate). R. C. Blinn, F. A. Gunther, and M. J. Kolbezen (*J. Agric. Food Chem.*, 1954, **2**, 1080—1083).—A very specific method is described for the microdetermination of ethyl *pp'*-dichlorobenzilate in citrus extractives. The method is based on hydrolysis to *pp'*-dichlorobenzilic acid followed by selective oxidation to *pp'*-dichlorobenzophenone, which is determined either by its absorption at 264 mμ. or by that of its 2 : 4-dinitrophenylhydrazone in alcoholic alkali at 510 mμ. The method is reproducibly sensitive to about 15 μg. in 3 g. of citrus extractives. S. C. JOLLY.

Detection of fungicides and insecticides by microbiological techniques. R. Angelotti, J. A. Fletcher, H. D. Brown, and H. H. Weiser (*Proc. Amer. Soc. hort. Sci.*, 1954, **63**, 285—288).—Several bacteria, yeasts, and protozoa were used as test organisms for Dithane, DDT, benzene hexachloride, Lindane, and Parathion. *Micrococus pyogenes* was inhibited by 3·3 p.p.m. of Dithane but no bacteria used were affected by Parathion (222 p.p.m.). DDT at concn. of 20 p.p.m. had no effect on the test organisms. L. G. G. WARNE.

Chemical measurements of methyl bromide concentration in relation to kill of fungi and nematodes in nursery soil. D. E. Munnecke and D. L. Lindgren (*Phytopathology*, 1954, **44**, 605—606).—Stacks of flats filled with soil containing 18% of peat moss were sealed in gasproof sheeting. Methyl bromide (4 lb. per 100 cubic feet) was released beneath the cover at the top of the stack and after one hour the concn. of gas was uniform throughout the stack. Fungi and nematodes were killed at all positions in the stack. T. G. MORRIS.

Disease-resistance factors in wheat. Electrophoretic and chromatographic analysis of protein extracts of wheat seedlings. R. E. Barrett and J. H. McLaughlin (*J. Agric. Food Chem.*, 1954, **2**, 1026—1029).—Based on electrophoretic and chromatographic examination of aq. extracts, no differences were found in the protein from healthy and diseased plants of a disease-resistant variety (Pawnee), but with a disease-susceptible variety (Michigan Amber) the protein from diseased plants had lower amino-N and greater carboxyl contents, and lower negative electrophoretic mobility than had that from healthy plants. The susceptibility of Michigan Amber seedlings to *Puccinia triticira*, Race 9, may be associated with high amino-N content and/or low carboxyl content, or with a high amino-N to carboxyl ratio. S. C. JOLLY.

Effect of bunt incidence of the yield of wheat in Eastern Washington. A. E. Slinkard and F. C. Elliott (*Agron. J.*, 1954, **46**, 439—441).—There were significant negative linear relationships between the % of smutty heads and yields of grain from spring and winter wheats at eight locations. Yield reductions due to bunt incidence were greater at high- than at low-yielding locations. A. H. CORNFIELD.

Some conditions influencing the results from maize seed treatment tests. B. Koehler (*Phytopathology*, 1954, **44**, 575—583).—A discussion. T. G. MORRIS.

Amino-acid composition of monosporidial cultures of *Ustilago zeæ* of different sex. J. E. DeVay (*Phytopathology*, 1954, **44**, 583—587).—No correlation was found between sex groups and the free amino-acid content, as determined by two dimensional chromatography, of cultures of monosporidial lines of *Ustilago zeæ*. The bound amino-acid content of lines of different sex differed little. No relationship was apparent between the bound and free amino-acids synthesised in culture by lines of *U. zeæ* and their sex and pathogenicity. T. G. MORRIS.

Grower trials for control of wireworms attacking maize. W. M. Kulash (*J. econ. Ent.*, 1954, **47**, 863—866).—Soil treatment with Heptachlor for wireworm control was more effective than seed treatment, and was about equal to combined seed- and soil-treatment. Aldrin, Dieldrin, or Heptachlor seed treatments were more effective than Lindane used alone or with a fungicide (50% *N*-trichloromethylthiotetrahydrophthalimide). Spraying in the drill row at sowing time with Aldrin, Dieldrin, or Heptachlor gave some protection against wireworm attack; Lindane was ineffective by this method. A. A. MARSDEN.

Effect of rates of nitrogen application on greenbug damage to oats, rye, and ryegrass. C. C. Blickensdorff, D. D. Morey, and G. W. Burton (*Agron. J.*, 1954, **46**, 338).—The extent of injury by greenbug (*Toxoptera graminum*, Rond.) to oats was greater than to rye, whilst ryegrass was affected but slightly. The extent of injury to rye and oats decreased with increasing applications of N to the soil. A. H. CORNFIELD.

A yellow spot virus in potato varieties in Aroostook County, Maine. R. Bonde and D. Merriam (*Phytopathology*, 1954, **44**, 608).—The disease is described. Vectors were not determined. Yield is affected. T. G. MORRIS.

Hypersensitivity of *Solanum tuberosum*, L. hybrids to potato virus Y (*Marmor upsilon*, Holmes). M. K. Corbett (*Dissert. Abstr.*, 1954, **14**, 1873).—Inbred lines of potatoes were mechanically inoculated in the greenhouse with four strains of virus Y. The clones which gave no reaction or which produced local lesions without systemic infection, on being planted in exposure field plots, nearly all became systemically infected. Virus from these was used mechanically to inoculate healthy plants that appeared to be hypersensitive in the original tests, and local lesions resulted with no systemic infection. This reversal in reaction appeared to be caused by a difference in method of inoculation. This is discussed, including inoculation by aphids, or by graft. Application of indolylacetic acid in lanolin to the petioles of inoculated leaves did not affect local lesion formation, but delayed leaf abscission. E. M. J.

Evaluation of potato leaf injury caused by leaf-hoppers, flea beetles, and early blight. A. A. Granovsky and A. G. Peterson (*J. econ. Ent.*, 1954, **47**, 894—902).—Measurements of foliage injury on potatoes gave a useful evaluation of insecticides supplemental to the information obtained from insect population counts and yields. A. A. MARSDEN.

Resistance of swede varieties to dry-rot [*Phoma lingam*, (Tode) Desm]. I. A. M. Cruickshank and T. P. Palmer (*N.Z. J. Sci. Tech.*, 1954, **36, A**, 122—128).—In trials with 45 varieties of swedes, the swede bulb was inoculated with suspensions of *P. lingam*. All inoculated bulbs showed some dry rot. No variety could be graded as consistently "resistant"; some contained resistant plants, of which Weibulls Balder, Weibulls Wilhelmsberger, and one strain of Wilhelmsburger Otofe of unknown origin were outstanding. G. HELMS.

The lucerne weevil: how to control it. Anon. (*U.S. Dep. Agric., Leafl.* No. 368, 18 pp.).—The natural history of the weevil (*Hypera postica*) is described. Killing overwintered adults in the early spring by the application of Dieldrin or Heptachlor at the rate of 4—5 oz. per acre as spray or dust, or Chlordane at 1½—2 lb. per acre, is recommended. Summer treatment with similar chlorinated insecticides at similar dosages is recommended for lucerne grown for hay. L. G. L. UNSTEAD-JOSS.

Varietal reactions of *Trifolium subterraneum*, L., to Phaseolus virus 2 Pierce. E. M. Hutton and J. W. Peak (*Aust. J. agric. Res.*, 1954, **5**, 598—607).—Of subterranean clover varieties tested with the virus in the glasshouse, Nordham, First Early, Dwalganup, and Pink Flowered gave lethal necrotic reactions, while the rest developed mottles and chlorisis. In the field, the lethal-reactors were resistant to the virus. Resistance is dependent on a virus-inactivating system integrated with another enzymic system governing the development of lethal necrosis. The lethal reaction is heritable and dominant in most crosses. R. H. HURST.

Pathogenicity of seven species of *Pythium* on lucerne, sweet clover, and Ladino clover seedlings. J. E. Halpin, E. W. Hanson, and J. G. Dickson (*Phytopathology*, 1954, **44**, 572—574).—*Pythium debaryanum*, *P. irregulare*, *P. splendens*, and *P. ultimum* were most pathogenic and had similar effects on the hosts at all temps. from 16 to 28°. *P. parœcandrum* was less pathogenic, *P. arrhenomanes* had little effect, and *P. rostratum* was completely non-pathogenic. T. G. MORRIS.

Three-year test for meadow spittlebug control in lucerne. J. T. Medler (*J. econ. Ent.*, 1954, **47**, 842—847).—When tested as low-vol. emulsion sprays, chlorinated hydrocarbons were the most effective insecticides against *Philænus leucophthalmus* attacking lucerne; Dieldrin, Lindane, Toxaphene, and Methoxychlor in decreasing order gave the best results. Phosphates, including systemic insecticides, nitroparaffins, and insecticides of plant origin were ineffective. Some spittlebug eggs were parasitised by *Centrodora* n. sp. A. A. MARSDEN.

Clover leaf weevil control by autumn insecticide applications. J. H. Bigger and C. E. White (*J. econ. Ent.*, 1954, **47**, 927—928).—Autumn application of a DDT (1·5 lb. per acre) spray gave satisfactory control of clover leaf weevils, *Hypera punctata*. Addition of Parathion to this spray gave slightly poorer control of weevils and had no effect on aphid populations in the following spring. The stronger growth of clover obtained in the spring following autumn treatment was better able to withstand aphid attack than was untreated clover. A. A. MARSDEN.

Spray combinations for control of apple pests in Connecticut. P. Garman (*J. econ. Ent.*, 1954, **47**, 731—734).—Eight spray combinations were applied to McIntosh apple trees, and seven were applied to the same trees in the following year. Methoxychlor–TDE–Captan, and DDT–Parathion–Phygon–Fertsam formulations gave the cleanest fruit. Late sprays and sprays that injured foliage affected the quality and flavour of the fruit. In flavour tests, apples sprayed with Pb arsenate–Glyodin–Captan were preferred to those receiving any other spray combination. Flavour analyses placed the sprays in order of preference which was opposite to that of pest control. A. A. MARSDEN.

Codling moth control experiments, 1950—1953. D. W. Hamilton, S. A. Summerland, and J. E. Fahey (*J. econ. Ent.*, 1954, **47**, 768—775).—None of three strains of codling moth larvæ, with different histories of exposure to DDT, developed resistance to DDT. DDT, Parathion, EPN, Diazinon, Metacide, CS-708, Methoxychlor, and Ryania gave the best control of this pest. Parathion and Metacide were highly effective against eggs, larvæ, and adults but showed little residual toxicity. Good control with DDT was obtained with deposits on the fruit of $\lessdot 7{\cdot}5$ μg. per sq. cm. Orchard tests showed that the best practical control was obtained with a DDT–Parathion combination. Addition of DMC or Compound 876 [1 : 1-bis-(*p*-chlorophenyl)prop-2-yn-1-ol] failed to produce any synergic effect with DDT against codling moth larvæ. A. A. MARSDEN.

Methoxychlor for codling moth control. F. P. Dean and E. J. Newcomer (*J. econ. Ent.*, 1954, **47**, 936—937).—Methoxychlor (50% wettable powder) sprays gave better control of codling moth than did DDT when used in the arid regions of the Pacific Northwest. A. A. MARSDEN.

Thiram for control of black spot of apples and pears. K. E. Hutton (*Agric. Gaz. N.S.W.*, 1954, **65**, 161—162).—The main advantages of Thiram over lime–S were that the former caused no foliage injury, did not restrict tree growth, and produced larger fruit of better quality. Thiram had a mild thinning effect on the variety Granny Smith. A. H. CORNFIELD.

Factors influencing the susceptibility of the plum curculio to lead arsenate. E. H. Smith (*J. econ. Ent.*, 1954, **47**, 871—879).—The influence of the age of the insects and of the presence of surface moisture on the susceptibilities of plum curculios, *Constrachelus nenuphar*, to Pb arsenate were investigated. Susceptibility was highest among (spring) adults of the overwintering brood, decreasing for several weeks and rising again late in the season. Single-brooded females (northern strain) had the highest LD_{50} values and caused more feeding injury compared with the multi-brooded (southern strain) summer adults. The effectiveness of Pb arsenate at three dosage levels was highest where the test insects had access to surface moisture. The extent of feeding and no. of insects feeding was greater on dry residues ; oviposition was less on wet residues and was $\propto$ the feeding. These differences were apparently due to ingestion of Pb arsenate taken with surface moisture. Such factors may account for certain seasonal variations in the effectiveness of Pb arsenate sprays on curculios. A. A. MARSDEN.

Translocation of radioactive phosphorus injected by the green peach aphid into tobacco plants. F. R. Lawson, G. B. Lucas, and N. S. Hall (*J. econ. Ent.*, 1954, **47**, 749—752).—*Myzus persicæ* feeding on tobacco plants treated with ^{32}P became radioactive. ^{32}P was found in the fæces of the aphids, in or on cast skins, and in nymphs born to radioactive mothers. ^{32}P entering the leaf from feeding aphids was translocated to other parts of the plant. Part of the aphid injury to tobacco is due to injected salivary secretions absorbed and translocated in the plant. A. A. MARSDEN.

Peach silver mite control. E. W. Anthon (*J. econ. Ent.*, 1954, **47**, 866—868).—For the control of the peach silver mite, *Vasates cornutus*, Systox, Chlorobenzilate, Compound 876 [bis-(*p*-chlorophenyl-ethynylcarbinol)], R–242 wettable powder (*p*-chlorophenyl phenyl sulphone), and Aramite gave good but varying control of this pest. DMC gave an excellent initial kill but had poor residual action. Malathion- and TEPP-treated plots showed a significant increase of mites over untreated plots. A. A. MARSDEN.

Control of Georgia peach pests in 1953. O. I. Snapp (*J. econ. Ent.*, 1954, **47**, 909—912).—Wettable powder formulations of Dieldrin–Parathion in two split schedules, Parathion, EPN, Dieldrin, Aldrin, Heptachlor, Endrin emulsion, and CS–728 all gave effective control of plum curculios, *Conotrachelus nenuphar*, attacking peaches. In cage tests, Malathion and Parathion wettable powders showed good residual toxicity to adult curculios ; the residual val. of Diazinon was poor. Aldrin, Dieldrin, Heptachlor, and Isodrin used as soil insecticides were all highly effective against curculio larvæ. $C_6H_6Cl_6$, DDT, and Parathion tested as trunk sprays, and emulsions of $C_8H_4Cl_2$, and trichlorobenzene applied to the soil at the base of the tree gave good control of the peach tree borer, *Sanninoidea exitiosa*. Parathion or $C_6H_6Cl_6$ sprays controlled a heavy infestation of the lesser peach tree borer, *Synanthedon pictipes*. A. A. MARSDEN.

Ovicidal action of Parathion in control of the peach tree borer. E. H. Smith and A. W. Avens (*J. econ. Ent.*, 1954, **47**, 912—917).—Parathion residues on bark were $\sim$3 times as heavy as on leaves : bark residues also weathered more slowly than did leaf residues. A single Parathion spray gave toxic resides for $\lessdot$13 days after application. From 2 to 6 days exposure to residues or sprayed surfaces were required for 100% kill of peach tree borer eggs. The embryo in the affected eggs apparently developed normally to hatching point but failed to emerge from the chorion. The mode of ovicidal action of Parathion is discussed. A. A. MARSDEN.

Residual action and toxicity of Methoxychlor and Parathion to the cherry fruit fly. C. A. Johansen, W. E. Westlake, L. I. Butler, and R. E. Bry (*J. econ. Ent.*, 1954, **47**, 746—749).—Although emulsifiable Methoxychlor formulations left a greater residue than did wettable Methoxychlor formulations, the former caused less mortality of cherry fruit flies. Wettable Parathion gave greater deposits and higher fly mortalities than did emulsifiable Parathion. Parathion–Methoxychlor combinations showed no greater toxicity to *Rhagoletis cingulata* than did either alone. A. A. MARSDEN.

Influence of Douglas fir sawdust and certain fertiliser elements on the incidence of red-stele disease of strawberry. E. K. Vaughan, A. N. Roberts, and W. M. Mellenthin (*Phytopathology*, 1954, **44**, 601—603).—Douglas fir sawdust was used as a 4-in. surface mulch or incorporated into the top 6—8 in. of soil. Side dressings of fertiliser were applied to both sides of rows of strawberries planted in the spring. Fresh sawdust incorporated in the soil required increased amounts of N. Red stele disease due to *Phytophthora fragariæ*, Hickman, was more abundant on plants heavily treated with N. K and P had little effect. Plots mulched with sawdust showed increased incidence of the disease. There was little interaction between fertiliser and sawdust in their effects on the disease. T. G. MORRIS.

Importance of virus diseases in the cultivation of strawberries in the United States. G. M. Darrow, A. C. Coheen, and P. W. Miller (*Proc. Amer. Soc. hort. Sci.*, 1954, **63**, 547—552).—A review. L. G. G. WARNE.

Ethylene dibromide as a fumigant for mangoes infested with the Mexican fruit fly. J. G. Shaw and F. Lopez D. (*J. econ. Ent.*, 1954, **47**, 891—893).—Mangoes infested with *Anastrepha ludens* were fumigated with $C_2H_4Br_2$ at 25° for 2 hr. at dosages of 2 to 24 oz. per 1000 cu. ft. Complete kill of eggs and larvæ occurred with a dosage of 12 oz. The flavour and appearance of ripe Manila mango fruit and its ascorbic acid content were unaffected by $C_2H_4Br_2$ fumigation. A. A. MARSDEN.

Virus diseases "big bud" of tomato and "yellow dwarf" of tobacco. A. V. Hill and M. Mandryk (*Aust. J. agric. Res.*, 1954, **5**, 617—625).—Both diseases were transmitted by an insect vector and by grafting, but not by sap inoculation. Big bud but not yellow dwarf was transmitted by dodder. *Nicotiana glauca*, Graham, was a symptomless carrier of both viruses. Potato was infected by big bud, but not by yellow dwarf. Big-bud transmission occurred during summer, whereas yellow-dwarf infection could occur throughout the year. R. H. HURST.

Effect of nutrition on the susceptibility of tomato, *Lycopersicum esculentum*, Mill., to the early blight fungus, *Alternaria solani*, (Ell. and Mart.) Jones and Grout. L. A. Schafer (*Dissert. Abstr.*, 1954, **14**, 1877).—Bonny Best tomato seedlings were grown in 15 different nutrient solutions in sand culture and at three weeks of age were inoculated with spores of *Alternaria solani*, infection records being taken 36 hours later. The highest % of infection occurred without P treatment, and the lowest with N-deficiency. There appeared to be a definite relationship between N and P regarding susceptibility of tomato to *Alternaria solani*. Hypotheses based on data presented in this paper are suggested which may account for this action. Differences in growth of the fungus were observed when it was cultured in extract from tomato seedlings grown in various nutrient solutions. E. M. J.

Relation of plant nutrition to disease development. VIII. *Verticillium* wilt of tomato. J. C. Walker, M. E. Gallegly, jun., J. R. Bloom, and R. P. Scheffer (*Amer. J. Bot.*, 1954, **41**, 760—762 ;

cf. *ibid.*, **36,** 613; **38,** 663).—Infected tomato plants grown in drip-sand culture showed more rapid initial development of the disease in high than in low concn. of balanced nutrient solutions, but differences became insignificant after 40 days' growth. Unbalanced reduction of N, but not of P or K, caused a retardation of the onset of the disease. P. S. ARUP.

Tomato stem borer. Anon. (*Agric. Gaz. N.S.W.*, 1954, **65,** 105—106).—The tomato stem borer (*Gnorimoschema plæsiosema*) is controlled by destroying the previous crop as soon as picking has ceased and spraying the new plants in the seed bed with 0·1% DDT. The DDT treatment is continued at weekly intervals for 6—8 weeks after transplanting. A. H. CORNFIELD.

Tests with DDT and other insecticides for control of the cabbage looper in Southern California. J. Wilcox and A. F. Howland (*J. econ. Ent.*, 1954, **47,** 937—938).—DDT (5 and 10%) dusts were significantly inferior to Toxaphene, Parathion alone or with DDT, Metacide, or Malathion for the control of *Trichoplusia in* attacking turnips and cauliflowers. A. A. MARSDEN.

Control of aphids on commercial greens crops by insecticides. R. R. Walton and D. E. Howell (*J. econ. Ent.*, 1954, **47,** 780—785).—Fourteen toxicants were tested in field and laboratory experiments against *Myzus persicæ* attacking spinach and *Rhopalosiphum pseudobrassicæ* on crucifers. Ethyl- and methyl-Parathion, Lindane, TEPP, $C_6H_6Cl_6$, and nicotine sulphate gave very promising control of aphids on greens crops. DDT, Chlorodane, Toxaphene, rotenone, sabadilla, and mixed pyrethrins–rotenone–piperonyl compounds were generally unsatisfactory. Relatively non-volatile materials were largely ineffective because of their inability to penetrate spaces formed by folds in the leaves and cavities in the foliage. A. A. MARSDEN.

Control of blackheart of celery. C. M. Geraldson (*Proc. Amer. Soc. hort. Sci.*, 1954, **63,** 353—358).—In " blackheart " young leaves in the centre of the plant develop lesions and finally become black in colour. Generally celery from blackheart areas (in Florida) had a low content of Ca. Foliar sprays of 0·5M- or 1·0M-aq. $CaCl_2$ or $Ca(NO_3)_2$ controlled the disease whilst sprays of Mg and Na salts increased its incidence. L. G. G. WARNE.

Seed treatments compared with other methods for controlling the onion maggot. A. G. Peterson and D. M. Noetzel (*J. econ. Ent.*, 1954, **47,** 852—859).—Either 25% Heptachlor (4 oz.), 40% Aldrin (2·5 oz.), or 50% Dieldrin (2 oz.) when mixed with Thiram (4 oz.) and pelleted on 1 lb. of onion seed with methyl cellulose as a sticker gave effective control of the onion maggot, *Hylemya antiqua*, from planting until harvest. Dry mixtures of Dieldrin or Aldrin and Thiram (2 oz. of each material) gave good control of maggots but this small quantity of Thiram may not be adequate for smut control. Broadcasting Heptachlor and Aldrin (3—4½ lb. per acre) and working the material into the top two inches of soil gave similar results. Insecticidal applications after emergence of seedlings were much less effective than pelleting seed, dry mixes without a sticker, or broadcast soil treatments. A. A. MARSDEN.

Three bacteria pathogenic on head lettuce in New York state. W. H. Burkholder (*Phytopathology*, 1954, **44,** 592—596.)—*Pseudomonas cichorii*, *P. marginalis*, and *Xanthomonas vitians* caused rotting of head lettuce. Cultural and physiological characteristics of the three are given, and their effects on other plants are described. T. G. MORRIS.

Screening tests with fungicides for control of broad-bean rust. H. Jacks (*N.Z. J. Sci. Tech.*, 1954, **36, A,** 274—279).—Of 33 fungicides tested, under glass, for control of *Uromyces fabæ*, (Pers) de Bary, the most effective were lime S, Colsul 40 (44% colloidal S), Cosan (70% S), Dithane Z-78 [Nabam + $ZnSO_4$ + $Ca(OH)_2$], Fermspray (70% Ferbam), Manzate (Mn ethylenebis-dithiocarbamate), Thirospray (50% Thiram), Fuclasin Ultra (70% Ziram), Flit 406 (50% Captan), Phygon XL (50% 2 : 3-dichloro-1 : 4-naphthaquinone), and Spergon w.p. (48% chloranil). G. HELMS.

French-bean rust (*Uromyces appendiculatus*) in New Zealand. R. M. Brien and H. Jacks (*N.Z. J. Sci. Tech.*, 1954, **36, A,** 280—285).—The symptoms, factors favouring infection and spread, and the morphology of the causal organism are described. Artificial inoculation of 40 varieties of dwarf and runner beans showed that repeat spraying with lime–S (1 in 150) plus colloidal S 2 lb.–100 gal. affords effective control. G. HELMS.

Bacteria and fungi in seeds and plants of certified bean varieties. W. C. Schnathorst (*Phytopathology*, 1954, **44,** 588—592).—Twenty-three species of bacteria and 8 of fungi were isolated from Idaho beans. Of those identified, 4 bacterial species were found only in seeds, 6 in both seeds and plant tissue, and 7 in plant tissue only. Four species of fungi were found in seeds and 1 in tissue. The genus *Bacillus* was the group found most frequently. None of the bacteria but all the fungi were pathogenic to 5 legume species tested. T. G. MORRIS.

Comparison of Demeton dusts and sprays on beans and strawberries. J. Wilcox and A. F. Howland (*J. econ. Ent.*, 1954, **47,** 945—946).—Demeton sprays and dusts gave very good control of the two-spotted spider mite, *Tetranychus bimaculatus*, on lima beans ; sprays were better than dusts against the western flower thrips. Sprays were consistently more effective than were dusts against these mites attacking strawberries, but all dosages tested of sprays and dusts gave excellent control of the strawberry aphid. The effectiveness of treatments significantly increased with the dosage. A. A. MARSDEN.

Virus diseases infecting hardy *Prunus* grown in Minnesota nurseries. P. R. Fridlund (*Dissert. Abstr.*, 1954, **14,** 1862).—The value of *Prunus tomentosa* as an index host in detecting and differentiating latent viruses and the symptoms of necrotic ring spot virus in this host are discussed. Some of the usual variables caused by diversity in virus, host, and environment were studied. *E.g.*, high constant temp. (30°) produced symptoms more rapidly (6—14 days) than a lower temp. (18°) (14—23 days), and it increased the severity of the shoot dieback and mottle symptoms. Low temp. increased the severity of necrotic spotting. Little natural transmission of the disease occurs in Minnesota. Control can therefore be effected by propagation from trees known to be free from necrotic ring spot. E. M. J.

Aphid transmission of the Winconsin pea streak virus. C. B. Skotland and D. J. Hagedorn (*Phytopathology*, 1954, **44,** 569—571).—Mature non-viruliferous aphids fed for various times on infected peas were transferred to healthy host plants, left for an inoculation period and then killed with a spray. Progressively greater transmission of the virus occurred as the acquisition period increased. The virus is probably non-persistent in the vector. The disease was transmitted from pea to red clover and broad bean, and from red and yellow sweet clover to peas. Length of acquisition period did not affect the transfer, but vector starvation slightly increased transmission. Plants with late symptoms were better sources of infection than those with earlier and milder symptoms. T. G. MORRIS.

Some effects of treating muskmelons with insecticides. W. D. Fronk and L. E. Peterson (*J. econ. Ent.*, 1954, **47,** 807—811).—Fruit on plots treated with Dieldrin, Aldrin, Chlordane, $C_6H_6Cl_6$, EPN, and a DDT–Parathion mixture had the least amount of injury by larvæ of the striped cucumber beetle, *Acalymma vittata*. Treatment with Methoxychlor, Aldrin, Lindane, Heptachlor, and DDT generally produced slightly more fruit than did untreated checks. DFDT, Toxaphene, and $C_6H_6Cl_6$ were highly phytotoxic to Hale's Best variety of muskmelon. A. A. MARSDEN.

Evaluation of interval and dosage in bollworm control. J. K. Walker, jun., W. J. Mistric, jun., and D. F. Martin (*J. econ. Ent.*, 1954, **47,** 824—826).—DDT sprays (1·5 lb. per acre) applied to cotton every 5 days gave better bollworm control and a greater yield of cotton than did the same amount of DDT at 7- or 10-day intervals, or 0·75 lb. of DDT at 5- or 7-day intervals. Toxaphene–DDT or Dieldrin–DDT sprays applied every 4 days were more effective than Aldrin–DDT sprays every 4 days, but all materials were equally effective against bollworms when applied every 8 days. A. A. MARSDEN.

Endrin spray for bollworm control. D. F. Martin and W. J. Mistric, jun. (*J. econ. Ent.*, 1954, **47,** 827—829).—Endrin (0·33 lb. per acre), Endrin–DDT (1 : 1) at 0·48 lb., Toxaphene–DDT (1 : 2) (2·91 lb.), γ-$C_6H_6Cl_6$–DDT (3 : 5) (0·87 lb.), and EPN–DDT (1 : 2) at 0·96 lb. per acre were all ~ equally effective in controlling bollworms. In another experiment Endrin (0·25, 0·34, 0·53 lb.), Endrin–DDT (1 : 2) (0·75 lb) and Toxaphene–DDT (1 : 2) at 2·92 lb. were all equally satisfactory. All treatments gave a marked increase in seed cotton yields but there were no real differences in yields amongst the various treatments. A. A. MARSDEN.

Comparative effectiveness of various phosphorus and chlorinated hydrocarbon insecticides for control of cotton pests. L. C. Fife and R. L. Walker (*J. econ. Ent.*, 1954, **47,** 803—807).—Methyl Parathion, Chlorthion, EPN, Endrin, Isodrin, and Strobane were tested in comparison with the recommended insecticides $C_6H_6Cl_6$, Heptachlor, Toxaphene, Aldrin, and Dieldrin against five species of insects attacking cotton. Methyl parathion (**I**) (<0·25 lb. per acre) as a dust or spray, and Chlorthion (**II**) (2·5%) dust gave good control of overwintering boll weevils but were less effective against summer broods than were the standard insecticides. At 0·35 to 0·5 lb. per acre both **I** and **II** gave good seasonal control of weevils ; at 0·25 lb. per acre they were effective against cotton aphids, two species of spider mites, and cotton leafworms. In some experiments yields were lower in Chlorthion-treated plots, regardless of dosage, than in plots treated with recommended insecticides. Results with EPN were erratic, but Strobane (2 lb. per acre) was effective against boll

weevils; Endrin and Isodrin (0·2 and 0·3 lb.) gave very promising control. A. A. MARSDEN.

Control of insects and spider mites on cotton in 1953. M. T. Young and R. C. Gaines (*J. econ. Ent.*, 1954, **47**, 753—756).—Sprays and dusts of Ca arsenate, various org. insecticides, and mixtures of these materials were tested in plot experiments for control of boll weevils, bollworms, and other lepidopterous larvæ, cotton aphids, cotton fleahoppers, two-spotted spider mites, and desert spider mites. Results are tabulated. A. A. MARSDEN.

Tests against cotton pests with some new dust and spray formulations. M. E. Merkl and E. W. Dunnam (*J. econ. Ent.*, 1954, **47**, 869—871).—Dust formulations, using a fully dispersible and non-wettable Ca carbonate as the diluent, had excellent dusting qualities and gave good control of boll weevils and boll worms. A stabilised 2% Endrin dust gave little control of weevils or worms, owing to poor coverage of the plants. Field tests with two new P compounds, OS—1836 (2-chlorovinyl diethyl phosphate) and OS–2046 (2-carbomethoxy*iso*propenyl dimethyl phosphate) applied as sprays at 0·125 to 0·5 lb. per acre gave very good kills of boll weevils, cotton leaf-worms, and at the higher dosages, of the beneficial insects, lady beetles. For control of the desert spider mite, *Tetranychus desertorum*, Chlorthion, Demeton, and Aramite gave 98—99% kill after five days and for up to 19 days. A. A. MARSDEN.

Tagging boll weevils with radioactive cobalt. F. H. Babers, C. C. Roan, and R. L. Walker (*J. econ. Ent.*, 1954, **47**, 928—929).—Field-collected adult boll weevils were dipped in radioactive $CoCl_2$ solution (containing ^{60}Co), and their radioactivity determined five days later. Addition of a small amount of wetting agent, Tergitol, No. 7, greatly increased the amount of ^{60}Co retained by the insects and reduced the amount removed by washing. Growing cotton plants immersed in a ^{60}Co solution required several hours before appreciable radio-activity was present in the leaves. After 24 hr. all parts of the plant were active, especially the cotton in the immature bolls. A. A. MARSDEN.

The cotton leaf perforator and its control in the southwest. W. A. Stevenson and W. Kauffman (*J. econ. Ent.*, 1954, **47**, 941—942).—A Toxaphene (15)–DDT (5%) dust gave better control of the cotton leaf perforator, *Bucculatrix thurberiella*, than did DDT alone. Endrin applied as an emulsion spray or as a dust was highly effective against these larvæ. A. A. MARSDEN.

Growth responses of *Cucurbita maxima* to insecticide treatment. W. D. Fronk and E. P. Lana (*Proc. Amer. Soc. hort. Sci.*, 1954, **63**, 289—296).—A no. of insecticides were examined. L. G. G. WARNE.

Analysis of soil and foliage material in connexion with sickle leaf disease of cacao in Ceylon. P. C. Crowther and W. D. Raymond (*Colon. Plant Anim. Prod.*, 1954, **4**, 257—258).—To ascertain whether the disease could be correlated with mineral deficiency in the soil, healthy and affected foliage were examined spectrographically and the corresponding soils analytically. The results (recorded) permitted no conclusive finding relating to the cause of sickle leaf disease. G. HELMS.

Trapping hornworm moths. C. F. Stahl (*J. econ. Ent.*, 1954, **47**, 879—882).—Large numbers of the tobacco hornworm moth, *Protoparce sexta*, and the tomato hornworm moth, *P. quinquemaculata*, were captured in bait traps (using *iso*amyl salicylate) and in electric light traps. Although the sexes were about equal in the field, only about a quarter of the tobacco hornworm moths caught in the light traps were females. The use of both types of traps had little effect on abundance of, or damage caused by, hornworm larvæ on tobacco near the traps. A. A. MARSDEN.

Nematodes in relation to brown root rot of tobacco in Ontario. W. B. Mountain (*Canad. J. Bot.*, 1954, **32**, 737—759).—The rot is caused by the root-lesion nematode, *Pratylenchus* species. The lesions are further broken down by other soil organisms, involving at least two species of *Pratylenchus*. Nine other parasitic nematodes are also associated with tobacco roots. The relation between *P. minyus*, Sher. and Allen, 1953, and the tobacco host is detailed. (42 references.) R. H. HURST.

Brick red stain of Sitka spruce and other wood substrata. R. W. Davidson and F. Lombard (*Phytopathology*, 1954, **44**, 606—607).—The stain is caused by the fungus *Ascocybe grovesii*, Wells. T. G. MORRIS.

Pathology of *Electroderma deformans* on Ponderosa pine. P. C. Lightle (*Phytopathology*, 1954, **44**, 557—569).—A dissertation. T. G. MORRIS.

Insecticide deposits for control of elm bark beetle. J. G. Matthysse, H. C. Miller, and H. E. Thompson (*J. econ. Ent.*, 1954, **47**, 739—746).—DDT suspensions on American elm weathered too rapidly for use against insect vectors, *Scolytus multistriatus* and *Hylurgopinus rufipes*. DDT emulsions gave deposits which were toxic to bark beetles over a long period except in the tops of tall trees. Annual treatment with DDT to prevent Dutch elm disease is inadvisable due to tree injury, and also to the subsequent increased mite and aphid populations. In the laboratory, Dieldrin, Parathion, and Lindane were equal or superior to DDT against bark beetles. Dieldrin applied by a rust blower to city shade trees was effective against bark beetles at lower dosages than was DDT. A. A. MARSDEN.

Some factors affecting seed transmission of Safflower rust. O. H. Calvert and C. A. Thomas (*Phytopathology*, 1954, **44**, 609).—Safflower rust is caused by *Puccinia carthami*, Cda. Safflower seed heavily dusted with urediospores gave uninfected seedlings, but seed dusted with teliospores gave up to 90% rusted seedlings. Infection from teliospores increased as temp. decreased. T. G. MORRIS.

Epidemic of *Phytophthora* leaf fall of Hevea rubber trees in Costa Rica. J. B. Carpenter (*Phytopathology*, 1954, **44**, 597—601).—The course of the epidemic is described. Complete defoliation occurred in most cases, resulting in the loss of seeds and new shoots. T. G. MORRIS.

***Poria* root rot.** Anon. (*Rubb. Res. Inst. Malaya Plant. Bull.*, 1954, 110—111).—Brief notes on the disease, which is similar to that of *Poria hypobrunnea* in Ceylon, are given. It is destroyed by 2% $CuSO_4$ and may be prevented by not leaving tree stumps to rot in the ground. E. G. BRICKELL.

EPN for control of the hickory shuckworm on pecan. M. R. Osburn (*J. econ. Ent.*, 1954, **47**, 931).—Three applications of a 25% EPN spray (2 lb. per 100 gal. of water) gave the best control of *Laspeyresia caryana* attacking pecans. These treated nuts had a higher % of oil and were of better quality than were nuts from trees receiving any other treatment or no treatment. Nuts from untreated trees had little commercial value. The black pecan aphid, *Melanocallis caryæfoliæ*, and the mite *Tetranychus hicoriæ* were also partly controlled by the EPN sprays. A. A. MARSDEN.

Vinegar fly investigations in Northern California. A. E. Michelbacher and W. W. Middlekauf (*J. econ. Ent.*, 1954, **47**, 917—922).—Adult fly activity and oviposition habits are described. When applied by aeroplane under cool temp. conditions at 1 lb. per acre in 10 gal. of water, Dieldrin gave the best control of *Drosophila melanogaster* in the field. A 10% Q–137 dust and a Malathion–sugar spray also gave promising control. A. A. MARSDEN.

Effect of humidity and other factors on the upper thermal death points of the chinch bug. F. E. Guthrie and G. C. Decker (*J. econ. Ent.*, 1954, **47**, 882—887).—The upper thermal death points of adult chinch bugs, *Blissus leucopterus*, at eight temp., and five R.H. were determined. Data showed a reversal in the effect of R.H. as the temp. increased. At ~50° a point of equilibrium was reached where mortality was the same regardless of R.H. At lower temp., survival was greater at high R.H., and at higher temps. survival was favoured by low R.H. Longevity during exposure to high temps. was greatly increased if chinch bugs were provided with food as a source of moisture. Both replacement of lost moisture and cooling were important factors in increased longevity with feeding. A. A. MARSDEN.

Susceptibility to acaricides of two-spotted spider mites in the egg, larval, and adult stages. W. Ebeling and R. J. Pence (*J. econ. Ent.*, 1954, **47**, 789—795).—The LD_{50} were determined for 16 acaricides used as wettable powders and/or emulsifiable concentrates against various stages of *Tetranychus bimaculatus* on bean leaves. With Aramite and the org. phosphates, the larvæ were less susceptible than the adults. For Chlorobenzilate, DMC, R–242 (*p*-chlorophenyl phenyl·sulphone and related materials) and Compound 876 [bis-(*p*-chlorophenyl) ethynyl carbinol], the LD_{50} were similar for larvæ and adults. With Neotran, Ovotran, Compound 923 (2 : 4-dichlorophenyl benzenesulphonate), Karathane, DN–111, and DN–289, the larvæ were the more susceptible. With all acaricides except Neotran, Ovotran, and Compound 923, the eggs were the most resistant stage. The ratio of the LD_{50} for eggs : adults was particularly high with org. phosphates and Aramite, very low concn. of these materials being required to kill the adults. Non-systemic acaricides were applied to the upper surfaces of bean leaves and adult mites were placed on the lower, untreated surfaces; the LD_{50} were 18·8 times higher than when mites were placed on treated surfaces. Emulsifiable concentrates were generally initially more effective than wettable powders against all stages, but the latter showed a longer residual toxicity against adult mites. A. A. MARSDEN.

Aërial microsclerotia of *Verticillium* resulting from conidial anastomosis. S. Wilhelm (*Phytopathology*, 1954, **44**, 409—619).—Descriptive. T. G. MORRIS.

The fate of *Verticillium albo-atrum* R. & B. in muck soil as affected by various species of fungi. K. S. Wilson (*Dissert. Abstr.*, 1954, **14**,

1516).—The most satisfactory methods of sterilising muck soil were steam under pressure and intermittent steam methods. The microflora contained numerous fungi antagonistic to the isolates of *V. albo-atrum*, 62 organisms of 268 were inhibitors, as indicated by the " T " streak method. Eight antibiotics were assayed against *V. albo-atrum*, rimocidin and chloromycetin being the most effective. *Verticillium* can readily colonise sterilised muck soil, but it is a poor competitor against soil flora. Rimocidin reduced the incidence of disease in tomatoes caused by *V. albo-atrum* No. 9 and 16 antagonistic fungi modified the pathogenic effects. E. M. J.

Effects of certain insecticides upon unhatched larvæ of the pale western cutworm in the laboratory. L. R. Faulkner (*J. econ. Ent.*, 1954, **47,** 929—930).—Nine org. insecticides were applied as emulsifiable concentrate sprays to unhatched larvæ within the egg capsules. Lindane gave the highest mortalities, followed by Metacide, Aldrin, Demeton, Dieldrin, Malathion, and Parathion. TDE and DDT failed to give significant kills of unhatched larvæ.
A. A. MARSDEN.

Estimates of populations and sampling variance of European chafer larvæ from samples taken during the first, second, and third instar. R. H. Burrage and G. G. Gyrisco (*J. econ. Ent.*, 1954, **47,** 811—817).—Various sampling procedures were tested with *Amphimallon majalis*. A procedure which is satisfactory for sampling populations during one instar may not be applicable to the same population during other instars. A. A. MARSDEN.

Bronze orange bug. Anon. (*Agric. Gaz. N.S.W.*, 1954, **65,** 104—105).—The bronze orange bug may be controlled during the winter by 0·05% DDT sprays. Third and fourth stage bugs can be controlled with DDT or $C_6H_6Cl_6$ combined with the routine Cu sprays.
A. H. CORNFIELD.

Control of springtails. Anon. (*Agric. Gaz. N.S.W.*, 1954, **65,** 32—33).—Springtails were controlled by soil applications of nicotine sulphate (1 fl. oz. per 4 gal.) or 0·1% $C_6H_6Cl_6$ sprays. Application of DDT dust to the soil surface was ineffective.
A. H. CORNFIELD.

Relative effectiveness of ten fumigants to adults of eight species of stored-product insects. D. L. Lindgren, L. E. Vincent, and H. E. Krohne (*J. econ. Ent.*, 1954, **47,** 923—926).—The LD_{50} and LD_{95} of 10 fumigants were tested against eight species of adult stored-product insects at 2- and 6-hr. exposures. In general the toxicity of the fumigants to all the insects tested at LD_{95} for 2-hr. exposure was in the order acrylonitrile > HCN > chloropicrin > $C_2H_4Br_2$ > MeBr > ethylene oxide > C_2H_4ClBr > methallyl chloride > CS_2 > $C_2H_4Cl_2$. With 6-hr. exposures the $C_2H_4Br_2$ and MeBr reversed their positions in this series. A. A. MARSDEN.

Sprayers for experimental plots. G. E. Page (*Agric. Engng*, 1954, **35,** 498—499).—A small greenhouse sprayer and a small field plot sprayer are described. A. H. CORNFIELD.

American foulbrood of honey bees—how to control it. A. S. Michael (*U.S. Dep. Agric., Fmrs Bull.*, No. 2074, 12 pp.).—The disease is caused by *Bacillus larvæ*, a spore-forming organism. The diagnosis of this and allied brood diseases, such as European foulbrood and sacbrood, is minutely described and the correct method given for its control by burning the colony, and for its prevention by use of sulphur drugs. L. G. L. UNSTEAD-JOSS.

Effect on honey bees of DDT plus superphosphate applied as a dust to white clover pasture. T. Palmer-Jones, F. A. Bartrum, I. W. Forster, and D. L. Harrison (*N.Z. J. Sci. Tech.*, 1954, **36, A,** 177—192).—DDT–superphosphate mixture applied to white clover pasture at a rate of 2 lb. of 100% DDT per acre, for grass grub control, repelled bees for some days after application but had no significant adverse effect on either the mortality of the bees contacting the dusted clover flowers or on the hives. G. HELMS.

Use of honey bees as pollinators in unheated glasshouses. G. Priestley (*N.Z. J. Sci. Tech.*, 1954, **36, A,** 232—236).—A honey-bee technique for pollinating plants for stock seed, in insect-proof glasshouses, is described, and the associated problems, *e.g.*, temp. shading, bee-mortality, and interplant differences in seed yield, are discussed.
G. HELMS.

Direct effects on climate on cattle. III. Diurnal trend in body temperature, respiration rate, and pulse rate. M. R. Patchell (*N.Z. J. Sci. Tech.*, 1954, **36, A,** 93—102).–Three pairs of monozygotic twin Jersey heifers were housed in a barn for seven 24-hour periods, and periodical readings of body temp., respiration and pulse rates were taken. Data obtained show a distinct diurnal trend in both body temp. and pulse rate, there being a peak at 5—6 p.m. and a min. at 4—6 a.m. G. HELMS.

Fertility of anœstrous ewes following injection of progesterone and pregnant mare serum. T. J. Robinson (*Aust. J. agric. Res.*, 1954, **5,** 730—731).—Progesterone was used alone and in combination with pregnant mare serum in breeding Suffolk, Suffolk crossbred, and Romney Marsh ewes in anœstrus. Although œstrus was established by the combination of hormones, lambing percentages were low. The conception rate was somewhat higher following a complete ovarian cycle. Factors possibly involved in this phenomenon are discussed. R. H. HURST.

Action of colchicine on spermatogenesis in rabbits with special reference to polyploidy. J. Kliesch and C. Schmidtke (*Z. Tierzucht. Zuchtungsbiol.*, 1954, **63,** 127—154).—Experimental data presented indicate that the effect of colchicine on mammalian chromosomes is similar to that in plants. A. G. POLLARD.

Factors which affect the utilisation of rations high in cellulose. C. C. Brooks (*Dissert. Abstr.*, 1954, **14,** 1865—1866).—Six trials involving 146 artificial rumina were conducted, and tests were made on the following additions in % of dry matter of the ration: molasses 4—16, maize oil 1—17, maize starch 4, lactose 4, lucerne ash 2, and several mineral mixes; and in p.p.m. stilbœstrol 2—20, œstrone 20, cholesterol 20. The substances which appeared to have most influence on digestion were used in two digestion trials with 20 yearling crossbred wethers. The digestion of cellulose was lowered by the addition of maize oil, not increased by mineral salts, increased by additions of stilbœstrol, œstrone, and cholesterol at 10—20 p.p.m. and increased by lucerne ash in the artificial rumen but not in the sheep except when the ration contained fat.
E. M. J.

Investigations into the response to the DL-methionine in the metabolism of adequately and inadequately fed pigs, hens, and chickens. H-W. Scharpenseel (*Arenata J. agric.*, 1954, **1,** No. 3, 35—64).—One of two 14-week-old pigs was fed a daily diet of barley meal and skimmed milk while the other received barley meal only. Both received methionine and cystine. In addition each pig was treated with 1·5 mc. of radiomethionine (^{35}S). Excretion of methionine in the urine began immediately after uptake, and in the first 5·5 days over 60% of the radiomethionine was excreted, most of the S appearing in the inorg. form, in the urine. 20% appeared in the fæces, the remainder being absorbed. The amount retained was similar in both animals. Similar experiments were conducted with groups of laying hens; one group (N) received a balanced diet of animal and plant protein, another group (M) received a plant protein with methionine added and the third group (M + A) received the plant protein with methionine and Aurofac. Of the methionine ingested, group N excreted 95%, group M 91%, and group M + A 94%. The quantity of radiomethionine retained was greatest in the liver and decreased in the order, kidney, lung, skeleton, intestines. 0·3% of the total applied activity was found in the eggs, the max. being 2—4 days after ingestion. T. G. MORRIS.

Leucine and histidine requirements for growth of suckling pigs. R. G. Eggert (*Dissert. Abstr.*, 1954, **14,** 1867).—Growth and feed efficiency were used as the criteria of measuring the effects of adding various levels of L-leucine in two experiments on young pigs taken from the sow at about two days of age and fed simulated " milk " diets *ad libitum* containing sufficient N ≡ 25% of the air-dry diet as protein, the dietary N being supplied by casein, purified amino-acids, and diammonium citrate. Data indicate that the L-leucine requirement of suckling pig is more than 1·00 but not more than 1·25% of this type of diet. In two experiments in which young Yorkshire pigs were fed dietary N furnished by purified amino-acids, diammonium citrate, and in the second experiment 1% of monosodium glutamate, receiving all ten of the growth-essential amino-acids, growth was not as rapid as would be expected on a diet in which the same amount of N was provided by casein. The pigs receiving the same diet minus histidine failed to grow normally, but resumed growth when histidine was added. In a similar test in which the basal diet contained a certain amount of casein and supplementary amounts of the ten amino-acids were added, except in one case where histidine was omitted, results indicated that the requirement of the young pig for histidine is ~0·3% of such a diet. E. M. J.

Preliminary note on the extraction of a bloat-promoting fraction from red clover. R. P. Newbold (*N.Z. J. Sci. Tech.*, 1954, **36, A,** 285—286).—Red clover known to produce bloat was frozen at − 10°, then rapidly thawed, and the vacuolar liquid expelled in a hydraulic press; 80 lb. of clover yielded 30 lb. of juice. With a variety of feeds, only those containing press juice caused bloating in cows. The conclusion is therefore that the cause of bloat is in the non-fibrous portion of herbage, and that the responsible factor(s) is in solution in the vacuolar liquid. G. HELMS.

Fractionation of the non-protein nitrogen of grassland herbage. W. S. Ferguson and R. A. Terry (*J. Sci. Food Agric.*, 1954, **5,** 515—524).—The total non-protein nitrogenous (NPN) fractions, obtained from oven-dried grassland herbage by hot-water extraction, was fractionated by 75% alcohol (some peptides pptd.), followed by

pptn. with Ag_2SO_4 (purines and some peptides pptd.), followed by passage through a cation-exchange resin [separation into (*a*) non-absorbed N compounds, including NO_3' and pyrimidines, (*b*) adsorbed compounds eluted with NaOH, including amino-acids, amides, NH_3, betaines, and peptides or " bound " amino-acids, and (*c*) basic compounds, including choline, and strongly adsorbed compounds not eluted with strong acid, probably mainly peptides and including nucleotides]. In a clover and a lucerne sample the proportion of total N present as NPN was 23—30%; 78—88% of the NPN was accounted for by amino-N after hydrolysis, amide-N, NH_2–N, NO_3'-N, purine-N, betaine-N, and choline-N.
S. C. JOLLY.

Thyroxine content of thyroactive iodinated proteins as determined by a radioactive isotope dilution technique. E. P. Reincke (*J. Dairy Sci.*, 1954, **37**, 1227—1232).—A procedure is described for determining thyroxine in thyroactive iodinated proteins by an isotope dilution technique using ^{131}I-labelled thyroxine. The " true " thyroxine content determined by this method is only about one-third of the apparent thyroxine content (fraction sol. in *n*-butanol).
S. C. JOLLY.

Antibiotics and thyroid size in growing chickens. W. J. Mellen and E. F. Waller (*Poultry Sci.*, 1954, **33**, 1036—1037).—Addition of aureomycin (75 g.), bacitracin (100 g.), or furazolidone (100 g. per ton of feed) to the diet of New Hampshire males increased body and thyroid wt. gains to eight weeks of age. A. H. CORNFIELD.

Antibiotics: question as to justification for their use in animal feeding. J. Grashuis (*Conserva*, 1954, **3**, 167—172).—Claims in favour of the use of antibiotics are critically examined, and a number of objections to the practice are considered in detail. The proposal to prohibit the use of antibiotics in animal feeding in Holland is supported. P. S. ARUP.

The mechanism of action of antibiotics in stimulating growth in animals on marginal or deficient diets. H. E. Schendel (*Dissert. Abstr.*, 1954, **14**, 1490).—Using baby pigs 48—96 hours old, and fed a synthetic diet, the antibiotics Terramycin and No. 802 increased gains significantly. Arsanilicacid was observed to produce significant increase in gains when fed at a level of 90 mg./kg. of dry matter of diet. Rimocidin, sulpho*iso*oxazole and nine surface-active agents failed to affect gains. Aureomycin also failed to stimulate the growth of a piglet fed a reconstituted skim-milk diet. Data suggest that the effect of Terramycin (found to increase growth significantly) on the total no. of micro-organisms in all intestinal sections from the duodenum to the cæcum is to increase their no. about 10-fold. In rats fed marginal or deficient diets aureomycin and penicillin were unable to increase gains, although the diets contained all known nutrients and casein as the source of protein. The most important mode of action whereby antibiotics are capable of sparing thiamine-deficient rats, is through an increased intestinal synthesis of the limiting nutrient. E. M. J.

Antibiotics for laying and breeding hens. D. H. Sherwood and T. T. Milby (*Poultry Sci.*, 1954, **33**, 1931—1033).—Addition of Terramycin (0·005 g.), aureomycin (0·006—0·050 g.), penicillin (0·002 g.), or mixed antibiotics (0·0107—0·0184 g. per lb. of feed) to the diet of three different breeds in a no. of experiments had little effect on egg production, feed efficiency, hatchability, or mortality.
A. H. CORNFIELD.

Effect of penicillin and forage juice on reproduction and growth of turkeys. S. J. Slinger, A. M. Morphet, E. C. Hunt, and W. F. Pepper (*Poultry Sci.*, 1954, **33**, 944—951).—Addition of forage juice concn. (5% level in the feed) or procaine penicillin *G* (0·0015 g. per lb. of feed) to a practical type turkey breeder diet increased hatchability slightly but did not affect egg production or feed efficiency. Addition of both supplements improved hatchability further but had no effect on egg production or feed efficiency. Forage juice showed no carry-over effect with respect to growth of the poults. Penicillin showed a carry-over effect only when the dams received forage juice as well. Poult growth was improved by addition of forage juice + penicillin to their diets to a greater extent than when only one supplement was added, but then only when the dams' diet contained penicillin. A. H. CORNFIELD.

Influence of feeding of antibiotics on intestinal flora of pigs. A. v. Szilvinyi and H. Leithenmayr (*Mitt. VersuchsSta. Gärungsgew.*, 1954, **8**, 103—106).—Supplementary dosing with aureomycin and penicillin suppresses all Gram-positive organisms (originally constituting ~12·5% of the total flora), but not the Gram-negative flora which comprises *E. coli* and *Salmonella* sp. The former group, of which seven species are isolated and identified, differs from *E. coli* in being more or less deficient in capacity to synthesise amino-acids and vitamins, and thrive only in media supplemented with vitamin B_{12}, or media in which *E. coli* has previously been cultivated. The observed effects of antibiotics is probably due to the fact that they promote the dominance of organisms capable of synthesising essential factors. P. S. ARUP.

Use of antibiotics in the food of fattening pigs. K. L. Robinson, W. E. Coey, and G. B. Burnett (*J. Sci. Food Agric.*, 1954, **5**, 541—549).—In a series of trials, weanling pigs were fed all-vegetable diets and diets containing fish meal, with and without procaine penicillin (**I**), both under *ad lib.* and restricted feeding systems. The responses, based on live-wt. gains, suggest that factors that promote keenness of appetite, such as antibiotics or fish meal, are favoured by *ad lib.* feeding, but do not exert their full effect on restricted feeding. Responses to **I** are small after the 100-lb. live-wt. stage. Addition of cyanocobalamin enhanced the growth-promoting effect of **I**. Some degree of retardation occurred when **I** supplementation was discontinued after an initial response. Antibiotic treatments had no significant effects on carcass conformation and did not give commercially inferior carcasses. S. C. JOLLY.

B-vitamin levels in blood of young dairy calves fed a milk-replacement diet with and without aureomycin. Q. T. Smith and R. S. Allen (*J. Dairy Sci.*, 1954, **37**, 1190—1197).—Feeding 40 mg. of aureomycin daily to Holstein calves on a milk-replacement diet up to 7 weeks of age followed by 80 mg. daily up to 12 weeks of age had no significant effect on blood levels of thiamine, riboflavin, pantothenic acid, niacin, and vitamin B_{12} activity. There was no significant difference between sexes, but certain trends with age were evident. S. C. JOLLY.

The metabolism of cobalt, vitamin B_{12}, intrinsic factor, leucovorin, and aureomycin by cobalt-deficient lambs. C. J. Kercher (*Dissert. Abstr.*, 1954, **14**, 1869).—The liver and gastro-intestinal contents of one normal and ten Co-deficient lambs were assayed for vitamin B_{12} using *Lactobacillus leichmannii* ATCC 4797. The concn. of vitamin B_{12} expressed in μg. per 100 g. of dry matter, was 310 in the liver, 60 in the rumen-reticulum, 29 in the omasum-abomasum, 49 in the duodenum-jejunum, 103 in the ileum, and 170 in the cæcum of normal sheep compared to 7 in the liver, 4 in the rumen-reticulum, 2 in the omasum-abomasum, 4 in the duodenum-jejunum, 7 in the ileum, and 11 in the cæcum of Co-deficient sheep. The indications were that synthesis of vitamin B_{12}, presumably bacterial, occurred in the lower intestinal tract. Intrinsic factor administered orally may be destroyed by rumen microflora before it reaches its site of action in the lower alimentary tract. The parenteral administration of leucovorin at levels of 71 μg., 5 mg., or 15 mg. daily was ineffective in curing Co-deficiency. This suggests that the major function of vitamin B_{12} in curing Co-deficiency is not the conversion of folic acid to folinic acid. The oral administration of 10 mg. of aureomycin HCl was also ineffective in curing Co-deficiency.
E. M. J.

Protein needs of fattening lambs fed shelled maize, varied amounts of maize silage and lucerne hay, and trace amounts of cobalt and copper. L. F. Bush (*Dissert. Abstr.*, 1954, **14**, 1866—1867).—Three experiments were designed using 330 western feeder lambs ranging in wt. from 38 to 75 lb., to compare the feed-lot performance of lambs getting maize silage as the only roughage with similar lambs fed 0·75 and 0·50 lb. of lucerne hay and a full feed of maize silage. One lot of 11 lambs was used to study the effect of adding trace amounts of Co and Cu to the rations. The measures of performance were the rate of gain, feed efficiency, finish or fatness, and net return per lamb over the cost of lamb and feed. Details are given and results are discussed. *E.g.*, lambs fed with the medium level of protein (11·0%) were significantly ($P < ·05$) fatter at the end of the experiment than those fed more protein; the amount of hay in the ration did not influence significantly ($P > ·05$) the rate of gain or degree of finish of the lambs; the lambs fed a ration with trace amounts of Co and Cu required less concentrates per unit of gain, had a lower feed cost, and made more profit than lambs fed a ration with the trace minerals added. E. M. J.

Effects of feeding arsenicals to growing-fattening lambs. Lloyd LaVerne Bucy (*Dissert. Abstr.*, 1954, **14**, 1486).—Four experiments are discussed: in (*a*) 36 lambs were used and the sources of arsenic were 3-nitro-4-hydroxyphenylarsonic acid, fed at levels of 0·002, 0·004, and 0·006% of the ration, and arsanilic acid and K arsenite fed in quant. to supply equal amounts of As, in (*b*) the arsenic levels were raised, in (*c*) arsonic acid was fed at 0·024% level, in (*d*) toxicity and toxicity symptoms were studied. Details are given, and of the two rations fed. All arsenical compounds caused cell breakdown in the liver and kidneys. Results indicated that additions of these As compounds to practical farm rations fed to growing-fattening lambs are of no value. E. M. J.

The nutritional limitations of maize-tankage rations for growing swine. J. N. Henson (*Dissert Abstr.*, 1954, **14**, 1487—1488).—Results of a feeding trial indicated the need for adding combined B-vitamins (riboflavin, Ca pantothenate, and niacin) and a Terramycin–vitamin B_{12} supplement to a tankage–lucerne meal mixture

which was self-fed with maize and mineral salts. In a second trial individual and combined effects of vitamin B_{12} and Terramycin were determined, on pigs fed a basal ration deficient in pantothenic acid: in pigs fed the basal ration + vitamin B_{12} + Terramycin deficiency symptoms were not produced. Results of a third test indicated that a maize–tankage ration supplemented with vitamins and Terramycin, but limiting in lysine and methionine was inadequate for optimum growth. Supplements of lysine and methionine failed to improve response, but addition of tryptophan stimulated growth. In a study of the effect of Terramycin on the protein and tryptophan needs of pigs, both Terramycin and tryptophan improved growth response and were capable of reducing the amount of protein required for a particular rate of gain. During late growth and fattening the most rapid and economical gains were produced by higher protein levels without antibiotic supplementation. E. M. J.

Vitamin B_{12} and choline in maize–soya-bean rations for starting poults. D. H. Sherwood and H. J. Sloan (*Poultry Sci.*, 1954, **33**, 1015—1021).—Poults (from hens receiving vitamin B_{12}) fed an all-vegetable diet required 5—10 μg. of added B_{12} per kg. of feed for max. growth during their first four weeks. The treatment had little effect on feed efficiency. Addition of choline (0·05—0·1%), betaine (0·1%), or methionine (0·3%), increased growth even in the presence of added B_{12}. High mortality occurred in some tests where choline was omitted. Prolonged storage lowered the amount of available choline in the diet. Vitamin B_{12} had a partial sparing action on choline with respect to preventing mortality. Methionine, but not choline, had a partial sparing action on B_{12}. Addition of choline to the diet reduced gizzard erosion. A. H. CORNFIELD.

Growth of Bronze turkeys. V. S. Asmundson and C. F. Pun (*Poultry Sci.*, 1954, **33**, 981—986).—Growth rates of male and female Bronze turkeys and correlations between body wt. and % growth rates at various ages up to 24 weeks are presented. Selection for early rapid growth can be made effectively at eight weeks of age whilst selection for wt. at six months may be made at 16 weeks of age. A. H. CORNFIELD.

Growth rate of cockerels and pullets. Chueng-Shyang Ma (*Poultry Sci.*, 1954, **33**, 1028—1031).—White Leghorn male chicks grew more rapidly than did females to nine weeks of age, even though both groups consumed the same amount of feed. When the birds were given intramuscular injections of testosterone propionate (0·0025 g. twice weekly) the growth rate of females was similar to that of untreated males, whilst the growth rate of males was depressed. A. H. CORNFIELD.

Rate of deposition and turnover of ^{32}P and ^{45}Ca in the tissues of laying hens. R. L. Shirley, J. C. Driggers, J. T. McCall, M. Nienberg, and G. K. Davis (*Poultry Sci.*, 1954, **33**, 932—936).—The concn. of ^{32}P and ^{45}Ca in the principal bones and non-osseous tissues of laying hens, from 0·25 hr. to 21 days after, intravenous injections of the two isotopes, are reported. The concn. of the two isotopes followed the same pattern in the bones, but in the non-osseous tissues the ^{45}Ca occurred in much smaller concn., and practically disappeared within 24 hr. of administration. The rapid deposition and subsequent turnover in the bones indicate that the two elements undergo especially rapid metabolism in the laying hen. A. H. CORNFIELD.

Phosphorus requirement of young chicks and poults. H. J. Almquist (*Poultry Sci.*, 1954, **33**, 936—944).—A review. A. H. CORNFIELD.

Availability of phosphorus from different sources for poults fed purified diets. R. A. Wilcox, C. W. Carlson, W. Kohlmeyer, and G. F. Gastler (*Poultry Sci.*, 1954, **33**, 1010—1014).—The P in $Ca(H_2PO_4)_2$ U.S.P. XIV, defluorinated phosphates B and C, and $CaHPO_4$ was highly available to poults. The P in steamed bone meal, defluorinated phosphate A, β-$Ca_3(PO_4)_2$, two commercial $CaHPO_4$, and "tribasic calcium phosphate" was of intermediate availability whilst that in imported rock phosphate A and B and three colloidal phosphates was of low availability. A. H. CORNFIELD.

Transfer of phosphorus to the hen's egg as traced with radiophosphorus. A. H. Smith, C. M. Winget, and J. R. Blackard (*Poultry Sci.*, 1954, **33**, 908—919).—Less than 2% of the ^{32}P injected subcutaneously into laying hens was transferred to the shells during the 12 days after injection. Less than 1% was transferred to the whites and 10·8% was transferred to the yolks during the same period. A large part of the shell P is deposited even after mineral deposition is virtually complete. Max. transference of ^{32}P to the yolk occurred in the 4th—5th day after injection. The max. sp. activity of inorg. P preceded that of org. P. There are two major P "pools" in the laying hen responsible for transferring P to the egg. A. H. CORNFIELD.

Influence of ethylenediaminetetra-acetic acid on serum calcium in male chickens. F. L. Coune and J. C. Driggers (*Poultry Sci.*, 1954, **33**, 1005—1009).—The extent of reduction of serum-Ca level by injection of ethylenediaminetetra-acetic acid (**I**) was dependent on the dose and rate and mode of injection. A slow (2 min.) intravenous injection of 0·1 g. of **I** per kg. of body wt. had little effect on serum-Ca level. A rapid (30 sec.) injection lowered serum-Ca to a fatal level. Where non-fatal doses were given serum-Ca rapidly returned to near normal. Intravenous injections reduced serum-Ca to much lower levels than did intraperitoneal, intramuscular, or subcutaneous injections. Ca gluconate prevented, whilst $MgSO_4$ had no effect on, the reduction of serum-Ca level due to **I** when injected simultaneously with **I**. A. H. CORNFIELD.

Effect of 2-acetamido-5-nitrothiazole and 2-amino-5-nitrothiazole on egg production, fertility, hatchability, and weight gains in turkeys. R. J. Price and C. A. Bottorff (*Poultry Sci.*, 1954, **33**, 952—957).—Inclusion of 0·0125—0·025% of 2-acetamido-5-nitrothiazole (Enheptin A) in the feed of turkeys from 11 to 43 weeks of age or 0·05—0·1% of 2-amino-5-nitrothiazole (Enheptin) from 17 to 19 weeks of age had no effect on egg production, hatchability, wt. gains, or feed consumption. The high level of Enheptin A and the low level of Enheptin reduced fertility somewhat, but this reduction was of little practical importance. A. H. CORNFIELD.

Effects of sub-freezing temperature exposure on the chicken embryo. II. Hatchability, chick weight, and survival to six weeks. R. E. Moreng and R. L. Bryant (*Poultry Sci.*, 1954, **33**, 987—991).—Exposure periods of up to 85 min. at −23·3° had little effect on hatchability of fertile eggs and developing embryos when the treatment was given to eggs incubated for up to 17 days. Eggs treated after this period lost their ability to hatch. Hatchability of the embryo declined sharply with longer exposure periods. A high proportion of the treated embryos which survived hatched and produced normal chicks. Chicks from treated eggs had a higher wt. at hatch but grew more slowly and had a higher mortality than did those from control eggs. A. H. CORNFIELD.

Presence of unidentified chick growth factor activity in dried whey prepared with a minimum of bacterial fermentation. H. L. Jones, G. F. Combs, and G. L. Romoser (*Poultry Sci.*, 1954, **33**, 930—932).—An acid-pptd. casein whey (prepared with a min. of bacterial fermentation) was as effective as was a commercial fermented whey product (both added at the 3% level to the feed) in increasing wt. gains and feed efficiency of chicks. Higher levels of either type of whey failed to increase growth further. A Cheddar cheese whey which had been prepared with prolonged fermentation improved growth when added at the 3%, but not at the 6%, level to the feed. A. H. CORNFIELD.

Hen manure, cobaltised and non-cobaltised, as a partial or total substitute of animal protein in the ration of birds. I. Effect on starting and growing birds. R. B. Gapuz, N. Novilla, and B. Gorospe (*Araneta J. Agric.*, 1954, **1**, No. 3, 23—34).—The effect of hen manure as a substitute for animal protein in the feed of starting and growing birds has been investigated. Birds fed an ordinary starting diet grew the best; the wt. at the end of eight weeks of those fed the same diet with less animal protein but 2% of hen manure, decreased as the amount of animal protein decreased. Hen manure cannot replace animal protein. When the manure (100 g.) was treated with 1 ml. of a solution containing 7 g. of $CoCl_2,7H_2O$ and 21 g. of $ZnSO_4,6H_2O$ per l. before drying and grinding, it could replace the animal protein in the diet for birds up to eight weeks old. Coccidiosis was present in all trials; the disease was not inhibited by hen manure in the diet. Egg production during the first month was better with the birds started on cobaltised diet. T. G. MORRIS.

Fate of perorally administered SO_4-sulphur in the body of laying hens. H. W. Scharpenseel, T. Velasco, and B. Barlicos (*Araneta J. Agric.*, 1954, **1**, No. 4, 38—43).—0·3 mc. of ^{35}S-labelled Na_2SO_4 was administered by catheter directly into the stomach of hens. The hens were kept for 7 days until excretion of radio S was at a min., when they were slaughtered. 90·5% of the ingested ^{35}S was excreted; 86·7% was in the inorg. form. Of the remaining 9·3%, the majority was found in the bones and flesh. No radioactive methionine was found in the liver. T. G. MORRIS.

Comparative study on the dry-mash and wet-mash feeding of layers (hens). R. B. Gapuz, F. Sapalicio, and A. Velasco (*Araneta J. Agric.*, 1954, **1**, No. 4, 1—4).—Hens one-year-old fed dry mash produced, during a period of five months, significantly fewer eggs than similar birds fed the same amount of mash moistened before distribution. T. G. MORRIS.

Effect of dubbing on egg production and viability. R. K. Cole and F. B. Hutt (*Poultry Sci.*, 1954, **33**, 966—972).—White Leghorn pullets from which the comb and wattle had been removed at eight weeks of age laid a few more eggs than did control up to 500 days of age. In cold weather egg production from dubbed birds was somewhat better than from controls, whilst the reverse was true in warm

weather. Dubbing had no effect on viability to 500 days of age, body wt., or age of sexual maturity. A. H. CORNFIELD.

Cottonseed meal in poultry feed. Distinctive yolk component in fresh eggs of hens fed gossypol. C. R. Grau, E. Allen, M. Nagumo, C. L. Woronick, and P. A. Zweigart (*J. Agric. Food Chem.*, 1954, **2**, 982—986).—The fresh yolks of eggs from hens fed gossypol contain a yellow component insol. in acetone but sol. in hexane–acetone mixture (3 : 1). Based on its light absorption at 400 mμ, the amount of this component in the yolk correlates with the amount of gossypol in the diet, although its absorption spectrum is different from that of gossypol. It may be possible to determine gossypol in cottonseed meal by biological assay based on the amount of the component in the yolks. S. C. JOLLY.

Transfer of protein in stored shell eggs produced by hens fed crude cottonseed oil. Robert John Evans, S. L. Bandemer, J. A. Davidson, D. H. Bauer, and H. A. Butts (*J. Agric. Food Chem.*, 1954, **2**, 1077—1080).—During the transfer of protein from the white to the yolk of stored eggs from hens fed cottonseed oil, ovalbumin is selectively transferred; the transferred protein contains ovalbumin 79, covalbumin 3, ovomucoid 15, and ovoglobulins 3%, compared with 60, 14, 14, and 12%, respectively, in the protein of fresh egg white. The transfer may be responsible for production (by interaction of Fe with covalbumin) of the salmon colour of the yolk and pink colour of the white and its decrease in size. S. C. JOLLY.

Effect of season, age, and storage conditions on the flavour of eggs and products made using eggs. J. V. Harns, E. A. Sauter, A. McLaren, and W. J. Stadelman (*Poultry Sci.*, 1954, **33**, 992—997).—Eggs laid during the winter months and stored at 22·2° yielded products (boiled and poached eggs, angel food cakes, and custards) of superior flavour to those laid by the same hens during the summer months. Eggs stored at 0° maintained their flavour for up to four months whether or not the shells were oiled. Oil treatment by itself did not maintain the flavour of eggs during storage. Breed of hen (White Leghorn or New Hampshire) or type of feed (one producing a light and the other a dark yolk) did not influence the flavour of fresh eggs. A. H. CORNFIELD.

Composition of eggs from individual hens maintained under controlled environments. A. H. Smith, W. C. Wilson, and J. G. Brown (*Poultry Sci.*, 1954, **33**, 898—908).—Wt. of the shell, white, and yolk, dry matter contents of white and yolk, total and inorg. P contents of the yolk, total P content of the white, and the K, Na, and Ca contents of the yolk and white of eggs from individual hens maintained at low and high environmental temp. are reported. The composition of eggs produced by each hen was individually characteristic. A. H. CORNFIELD.

Cooling rate of eggs. C. W. Hall and L. E. Dawson (*Poultry Sci.*, 1954, **33**, 919—924).—The rate of cooling and quality changes of eggs cooled in various containers in an experimental egg cooler were studied. Eggs cooled much more rapidly in wire baskets than in wooden or cardboard cases. Quality declined more rapidly with increasing no. of eggs in the cooler. A. H. CORNFIELD.

Isolation of pentachloronaphthalene from cottonseed feed pellets. R. T. Blickenstaff and J. E. Callen (*Anal. Chem.*, 1954, **26**, 1586—1589).—Pentachloronaphthalene (**I**) was isolated from cottonseed pellets by the following procedure. Finely ground pellets were extracted with ethyl ether in a Soxhlet extractor, and the unsaponifiable matter isolated by the usual procedure. This was dissolved in light petroleum and chromatographed on a column of alumina. Fractions containing Cl were extracted with a methanol–2 : 2 : 4-trimethylpentane mixture and the combined residues were crystallised from alcohol. The material isolated gave i.r. and u.v. spectra, *X*-ray diffraction patterns and m.p. in agreement with authentic **I**. As little as 8 p.p.m. of **I** can be isolated from cottonseed feed pellets by the procedure. G. P. COOK.

Reproductive rates and growth of purebred Brown Swiss cattle in Brazil. G. C. Carneiro and J. L. Lush (*J. Dairy Sci.*, 1954, **37**, 1145—1157).—Pertinent facts about the reproduction and growth rates of these cattle in Brazil are described as a step in determining factors responsible for lowering the adaptability of European breeds to tropical conditions. S. C. JOLLY.

Genetic variation and covariation in rate of maturity and level of production in dairy cattle. C. G. Hickman (*Dissert. Abstr.*, 1954, **14**, 1868—1869).—Records collected under the Dairy Herd Improvement programme in New York State were used to estimate the importance of differences in rate of maturity in selection programmes. Paired lactation records were available on 3912 cows between the ages of 18 and 48 months when first fresh. Rate of maturity was measured by age at first freshening and by increase in age-corrected milk and fat production from first to second lactation. Level of milk and fat production and the rate of maturity measurements were subjected to analyses for the estimation of variance components for sire, herd, herd × sire, herd × time period, and residual variation. The difference traits were about one-quarter to one-third as variable genetically as was level of production. The results of analysis are discussed. *E.g.*, heritability estimates ranged from ·21 to ·64 and ·26 to ·56 for milk and fat production respectively; ·05 to ·24 and ·06 to ·19 for milk and fat difference respectively; and ·05 to ·12 for age at freshening. Estimates of genetic correlations between level of production and increase from first to second lactation production indicate the true genetic correlation to be either zero or slightly positive. E. M. J.

Bovine genitalia. J. R. Perkins, D. Olds, and D. M. Seath (*J. Dairy Sci.*, 1954, **37**, 1158—1163).—From a study of 1000 bovine genitalia information is presented as (i) the possible variation in size of normal reproductive organs in cows, (ii) the establishment of fœtal membranes, (iii) the correlation between the size of the fœtus and the diam. of the uterus as an aid to estimating stage of gestation by rectal palpation, and (iv) the frequency of gross abnormalities in female reproductive organs. S. C. JOLLY.

Diluters for bovine semen. III. Effect of lactenin and of lactoperoxidase upon spermatozoan livability. R. J. Flipse, S. Patton, and J. O. Almquist (*J. Dairy Sci.*, 1954, **37**, 1205—1211).—Lactenin, concentrated by acetone fractionation of whey, is highly toxic to bull spermatozoa. Results with lactenin prepared by tryptic digestion of whey, dialysis and alcohol pptn. were inconclusive due to difficulty of removing trypsin from the prep. which was also toxic. Lactoperoxidase added to heated skim milk used as semen dilutent was not toxic. S. C. JOLLY.

Effects of varied rates of hay feeding on body weight and production of lactating dairy cows. T. G. Martin, G. E. Stoddard, and R. S. Allen (*J. Dairy Sci.*, 1954, **37**, 1233—1240).—Varying the rate of hay feeding within normal limits had no significant effect on body wt. changes (*B*) or, if total digestible nutrients (TDN) or estimated net energy (ENE) were constant, on milk production (*M*). *B* was not correlated with either *M* or efficiency of production. TDN and ENE available for *M* were highly correlated with *M*. Neither TDN or ENE could be judged superior as an estimator of the worth of the ration, although ENE was apparently more consistent over of a wide range of hay/concentrate ratios. Both protein and dry matter digestibility values declined as hay content of the ration increased. S. C. JOLLY.

Hormonal induction of lactation of identical twin dairy cattle. J. Hancock, P. J. Brumby, and C. W. Turner (*N.Z. J. Sci. Tech.*, 1954, **36, A,** 111—116).—In experiments with seven sets of twin heifers, the milk production from animals brought into lactation by hormone therapy was less than that of the corresponding parturient twin. Nevertheless the yields were sufficiently promising to anticipate that inducted lactation is within the realm of practicality. In comparison with "normal" production, the corresponding induced lactations were 10·8, 83·7, and 107% (these pairs were low producers) and 41·9, 49·1, 61·1, and 72·5% for the others. G. HELMS.

Effect upon milk production and body weight of varying withdrawal periods after thyroactive supplement feeding. E. W. Swanson (*J. Dairy Sci.*, 1954, **37**, 1212—1219).—Withdrawal over a period of 10 days of thyroactive feed supplement (3 lb. daily containing 15 g. of Protamone) from cows fed the supplemented ration for 10—14 weeks caused a sharp decline in milk yield and a temporary period of subnormal production. The decline was less rapid with 15-, 18-, 25-, and 30-day withdrawal periods and production did not become subnormal. Following withdrawal rapid gains in body wt. occurred accompanied by increases in paunch girth sufficiently large to account for nearly all the wt. increase as gastrointestinal fill. Minor changes only occurred in water balance during thyroactive feeding. S. C. JOLLY.

Actively cellulolytic rod-shaped bacteria of the bovine rumen. M. P. Bryant and R. N. Doetsch (*J. Dairy Sci.*, 1954, **37**, 1176—1183).—Each of the eight strains of anaërobic, Gram-negative non-motile, actively cellulolytic rod-shaped bacteria found in large no. in rumen contents belonged to one species, *Bacteriodes succinogenes*. Bicarbonate was an essential growth requirement and rumen fluid possibly contains an unidentified heat-, acid-, and alkali-stable factor that is not a common B vitamin, NH_2-acid, peptide, purine, pyrimidine, or mineral and is not present in several materials commonly used to grow nutritionally fastidious bacteria or in extracts from lucerne meal or bovine fæces. Only glucose, cellobiose, cellulose, and pectin were fermented by all the strains; large amounts of succinic and acetic acids and smaller amounts of formic acid were produced, and CO_2 was taken up in the fermentation of cellulose. S. C. JOLLY.

Relationships between preslaughter and post-slaughter evaluations of beef cattle. R. R. Woodward, J. R. Quesenberry, R. T. Clark,

C. E. Shelby, and O. G. Hankins (*U.S. Dep. Agric.*, 1954, Circ. 945, 23 pp.).—A report of growth and carcass records collected on 635 Hereford steers from 1942 to 1951 at the U.S. Range Livestock Experimental Station, Miles City, Mont. Birth and weaning weights, performance in the feed lot, grades, and body measurements are evaluated. (29 references.) E. G. BRICKELL.

Factors affecting sheep production. P. Q. Guyer (*Dissert. Abstr.*, 1954, **14,** 1867—1868).—Large Northwestern ewes (63), two years old, divided into two groups were bred respectively to a large Hampshire ram and a small Hampshire ram of superior mutton conformation. Half the ewes bred to each ram subsisted on winter pasture during gestation, except that hay was fed when weather conditions prevented grazing; the other ewes were fed in addition 2 lb. of concentrates per head daily the last sixty days of pregnancy. Twelve pertinent observations are listed: of these, *e.g.*, high production was obtained from extensive use of pasture and roughage; both bluegrass and fescue-ladino winter pastures were adequate nutritionally during gestation. Dystokias occurred in about 11% of the ewes, but could not be associated with either differences in size and types of sire or conformation of ewes, no lambs were lost as a result of the dystokias; the large size of the ewe was of more importance than size of ram in fat lamb production. E. M. J.

Effect of relaxin upon milk ejection. I. Let down effect upon sheep. D. D. Shaffhausen, R. M. Jordan, and A. E. Dracy (*J. Dairy Sci.*, 1954, **37,** 1173—1175).—An average of 39·1% of the total milk produced by ewes at various stages of lactation was obtained by hand milking; an additional 43·5% was obtained after injecting 500 G.P.U. of relaxin and a further 17·4 by subsequently evacuating the gland with 10 i.u. of oxytocin. S. C. JOLLY.

Methods–time measurement analysis of some milk plant cleaning operations. G. P. Marley, W. M. Roberts, and R. W. Llewellyn (*J. Dairy Sci.*, 1954, **37,** 1198—1204).—Methods are suggested for reducing labour costs in cleaning dairy equipment. S. C. JOLLY.

Ulnar epiphyseal cartilage width in normal and rachitic calves and its use compared to other methods of detecting rickets. J. W. Thomas, M. Okamoto, and L. A. Moore (*J. Dairy Sci.*, 1954, **37,** 1220—1226).—The width of the epiphyseal cartilage of the ulnar of Holstein and Jersey calves up to 240 days of age is reported. Significant differences occurred between breeds and between sexes at certain ages, but season of birth and season had no effect. Application of the technique to the detection of rickets is described. S. C. JOLLY.

Self-feeding of chopped hay. K. K. Barnes and B. Beresford (*Agric. Engng*, 1954, **35,** 551—553).—A vertical cylindrical hay cattle self-feeder is described. A. H. CORNFIELD.

Hot weather shelters for livestock. G. L. Nelson, G. W. A. Mahoney, E. R. Berousek, and F. Graybill (*Agric. Engng*, 1954, **35,** 638—643, 645).—The use of "sol-air temp." measurements for studying heat gains by various building and animal surfaces is described. A. H. CORNFIELD.

The application of the new synthetic insecticides with special reference to the control of external parasites in animals. R. Du Toit (*S. Afr. industr. Chem.*, 1954, **8,** 218—221).—Various methods of applying the two synthetic chlorinated hydrocarbon insecticides DDT and BHC and their results, with particular reference to cattle and sheep, are reviewed and discussed. G. C. JONES.

New coccidium of turkeys, *Eimeria subrotunda*, Nov. sp. (Protozoa: Eimeriidæ). E. N. Moore, J. A. Brown, and R. D. Carter (*Poultry Sci.*, 1954, **33,** 925—929).—Characteristics of the new species (exact origin unknown) are described and compared with those of the other known species of *Eimeria*. The new species is relatively non-pathogenic. Turkeys immunised to *E. subrotunda* were successfully infected with *E. innocua* and *E. dispersa*. A. H. CORNFIELD.

Pathology of the reproductive tract of laying pullets affected with Newcastle disease. G. Biswal and C. C. Morrill (*Poultry Sci.*, 1954, **33,** 880—897).—Mortality among birds artificially infected with Newcastle disease was 6% and among three groups of naturally infected birds 0, 7, and 25%. The Newcastle disease virus was isolated from ovarian and magnal tissues of artificially infected birds five and seven days after infection and from naturally infected birds seven days after symptoms appeared. Some of the infected birds laid imperfect and soft-shelled eggs. Eggs from infected birds showed reduced shell wt. and thickness 28—56 days after exposure to infection. Serum-Ca and -inorg. P decreased markedly during the active stage of the disease and were at their lowest levels when egg production was at its lowest. Changes in gross pathology due to infection are described. A. H. CORNFIELD.

Toxicity of Malathion to the northern fowl mite. L. E. Vincent, D. L. Lindgren, and H. E. Krohne (*J. econ. Ent.*, 1954, **47,** 943—944).—A combination treatment consisting of Malathion (4%) dust applied to the litter and nests and a 1 : 10 mixture with 40% nicotine sulphate applied by the drop method to each bird gave the most effective control of the northern fowl mite, *Bdellonyssus sylviarum*, on poultry. Eggs laid by hens given Malathion (50 p.p.m. in the feed) had no off-flavour. Malathion treatments had no effect on egg production or hatchability. A. A. MARSDEN.

Esters of 4-chloro-o-toloxyacetic acid. Dow Chemical Co. (B.P. 711,680, 29.7.52. U.S., 18.9.51).—The prep. of compounds 4 : 2 : 1-$C_6H_3MeCl{\cdot}O{\cdot}CH_2{\cdot}CO_2{\cdot}[C_2H_3Me{\cdot}O]_n{\cdot}R$ (R is alkyl or phenyl, n is $\geqslant 3$), useful as modifiers in plastic compositions, preservatives for wood, paper, and cellulosic textiles, and as plant-growth regulants, is described. Thus, a mixture of 4 : 2 : 1-$C_6H_3MeCl{\cdot}O{\cdot}CH_2{\cdot}CO_2H$ (200·5), conc. H_2SO_4 1, $(CH_2Cl)_2$ 200 c.c., and *iso*propoxypropoxypropanol isomers (177 g.), b.p. 204°, comprising mainly $Pr^i{\cdot}(O{\cdot}CH_2{\cdot}CHMe)_2{\cdot}OH$, is boiled during 4 hr. with continuous removal of H_2O, then neutralised with dil. aq. Na_2CO_3. The solvent layer is separated, washed with water, and distilled to leave *isopropoxypropoxypropyl 4-chloro-2-o-toloxyacetate*, n_D^{25} 1·4882. Other compounds made include: *methoxypropoxypropoxypropyl*, n_D^{25} 1·488, *1′-methoxyprop-2′-yl*, n_D^{25} 1·506, *butoxypropoxypropyl*, n_D^{25} 1·4868, *phenoxypropoxypropyl*, n_D^{25} 1·5302, mixed *1′-butoxyprop-2′-yl*, *butoxypropoxypropyl*, and *butoxypropoxypropoxypropoxypropyl*, n_D^{25} 1·4928, and also *1′-phenoxyprop-2′-yl*, and *phenoxypropoxypropoxypropyl* **4-chloro-2-toloxyacetate.** F. R. BASFORD.

Trichloroacetates of the chloroaryloxy-alkanols. Dow Chemical Co. (B.P. 710,406, 24.10.52. U.S., 23.10.51).—Trichloroacetates $CCl_3{\cdot}CO_2{\cdot}C_nH_{2n}{\cdot}OR$ (wherein $n=2$ or 3 and R is a chloroaryl radical) are claimed. 2-2′ : 4′-Dichlorophenoxyethanol and $CCl_3{\cdot}CO_2H$ in $C_2H_4Cl_2$ are gradually heated to 122° with continuous removal of $C_2H_4Cl_2$ and H_2O and re-cycling of the former giving 2-2′ : 4′-*dichlorophenoxyethyl trichloroacetate*, m.p. 55·5—56·5°. The following compounds are prepared: 1-2′ : 4′-*dichlorophenoxyprop-2-yl*, n_D^{25} 1·5361, 2-4′-*chloro-o-tolyloxyethyl*, m.p. 44°, 2-2′ : 4′ : 5′-*trichlorophenoxyethyl* **trichloroacetate,** m.p. 50—51°, 2-*o*-*chlorophenoxy*-, b.p. 137°/9 mm., 2-*p*-*chlorophenoxy*-, b.p. 130—135°/5 mm., 2-4′-*chloro-o-tolyloxy*-, m.p. 51—53°, 2-2′ : 4′-*dichlorophenoxy*-, m.p. 54—57·5°, 2-2′ : 4′ : 5′-*trichlorophenoxyethanol*, m.p. 66·5—68·5°, 1-*p*-*chlorophenoxy*-, b.p. 145·5—148·5°/10 mm., 1-2′ : 4′-*dichlorophenoxy*-, b.p. 151—159°/10 mm., 1-4′-*chloro-o-tolyloxy*-, b.p. 135°/3 mm., and 1-2′ : 4′ : 5′-*trichlorophenoxy*-**propan-2-ol,** m.p. 47·8—48°. H. WREN.

Herbicidal compositions. Monsanto Chemical Co. (B.P. 715,186, 21.10.52. U.S., 23.10.51).—Benzophenone (**I**), optionally substituted by alkyl of 1—5 C, and halogen, is dispersed in the aq. phase of an oil–water emulsion (in presence of an agricultural pesticide), to give a herbicidal composition. Thus, an emulsifying agent [a mixture of a *poly*ethylene glycol ester of tall oil fatty acids (~8 ethylene glycol groups) and Na alkylbenzenesulphonate] 0·2 and a solution of benzophenone 1% in *cyclo*hexanone are added to water, to give a spray composition which kills three-weeks-old maize plants within 1 week, with moderate injury to bean plants. F. R. BASFORD.

Fungicidal preparations. N.V. de Bataafsche Petroleum Maats. (B.P. 714,042, 16.12.52. Neth. 17.12.51 and 14.7.52).—Claim is made for a pourable fungicidal prep. comprising 10—75% by wt. of (*a*) a water-immiscible liquid having a viscosity at 20° below about 3000 centipoises and which does not solidify above 20° and which substantially does not include components boiling below 50°, (*b*) 0·25—25% by wt. of one or more emulsifying agents, and (*c*) 16—40% by wt. of water, the particle size of the solid components being below about 100μ and not more than ~30% by wt. of said solid components being dissolved in the water–immiscible liquid. A typical prep. contains S (45%), white oil (23%), Triton X-100 (4%), water (28%). Many other examples are given. H. WREN.

Insecticidal preparations. N.V. de Bataafsche Petroleum Maats. (B.P. 712,884, 31.10.52. Neth. 2.11.51).—Claim is made for an insecticidal preparation including one or more compounds of the composition 1 : 2 : 3 : 4 : 10 : 10-hexahalogeno-6 : 7-epoxy (or episulphido)-1 : 4-5 : 8-dimethano-Δ^2-octahydronaphthalene, with at 6 and 7 H, Cl, OH, NH_2, CN, hydrocarbon radical, hydroxy-alkyl (-aryl etc.), or CO_2H group, dissolved in a solvent b.p. >100°, which also contains in solution a resin in an amount up to 25% by wt. of the above epoxy- or episulphido-compound or compounds. The resin may be coumarone resin or colophony, the insecticidal ingredient may be Dieldrin and the solvent may be a hydrocarbon. H. WREN.

Insecticides of animal origin. Montecatini Soc. Gen. per l'Industria Mineraria & Chimica (B.P. 715,546, 7.5.52. It. 16.5.51).—Ants characterised by anal glands, especially *Dolichoderinæ*, *e.g.*,

Liometopum microcephalum Panz., *Tapinoma nigerrimum* Nyl., and *Iridomyrmex humilis* Mayr, are subjected to disintegration (grinding, optionally in presence of a carrier), drying at $>50°$, and milling, to give a powder containing an insecticidal agent *iridomyrmecin* (**I**), $C_{10}H_{16}O_2$ (empirical), m.p. 60—61°, $[\alpha]_D^{20} + 210°$ (in 4% solution in EtOH), of low toxicity to warm blooded animals. **I** may be recovered in conc. form by sublimation, distillation, or solvent extraction. As a guide to commercial output, 3500 g. of **I** can be obtained from 1×10^9 workers with stomach non-swelled with food, in the summer season. F. R. BASFORD.

Feed compositions containing choline chloride. Monsanto Chemical Co. (B.P. 713,779, 18.12.51. U.S., 29.12.50).—Choline phosphate 1—40 (3·5—10) is added to an aq. solution pH 6—8 of choline hydrochloride 60—99 (90—96·5 mol.) to give a non-corrosive composition (containing 60—75 wt.-% of choline salts), stable against discoloration in presence of Fe or Fe alloy, and suitable for use in the prep. of animal and poultry feed (as growth-stimulant and perosis preventative). F. R. BASFORD.

Veterinary prophylactic composition for the treatment of scours. Wisconsin Alumni Research Foundation (Inventor: K. P. Link) (B.P. 715,101, 18.4.52).—The composition comprises a vitamin K compound, *e.g.*, 2-methyl-1 : 4-naphthaquinone (Menadione) 1—2 and bovine (dairy cattle), sheep, or pig's plasma or serum 2500 g. containing immune (globulin) proteins. F. R. BASFORD.

2.—FOODS

Possible influence of the quality of rice in determining the nutritive value of the poor rice diet. V. Subrahmanyan, S. Kuppuswamy, and M. Swaminathan (*Bull. Centr. technol. Food Res. Inst., Mysore*, 1954, **3**, 272—276).—Results of animal experiments on the nutritive value of rice diets are surveyed. The large variations in the growth-promoting value of poor rice diets (1—10 g. per week for albino rats) are attributed chiefly to differences in composition due to variety; degree of milling of the rice, variation in the stock colony of animals, and/or seasonal changes may also have some effect. The possible influence of these and other factors on the growth-promoting value are discussed. The need for further work in elucidating the rôle of these factors and in standardising the composition of the poor rice diet so as to include, for example, tamarind, chilli, buttermilk, and *pan* is indicated. S. C. JOLLY.

Cereals in nutrition. Nutritive value of rice germ. M. C. Kik (*J. Agric. Food Chem.*, 1954, **2**, 1179—1181).—Based on feeding studies using albino rats, the introduction of rice for human foods and for animal feeds is recommended because of its high nutritive value. Data is presented on the protein efficiency of rice germ compared with milled rice, on the value of the proteins of rice germ supplementing those of milled rice, and on the amino-acid, vitamin, and mineral contents of rice germ. S. C. JOLLY.

Cereal storage effects. Deteriorative changes in the oil fraction of stored parboiled rice. D. F. Houston, Irving R. Hunter, E. A. McComb, and E. B. Kester (*J. Agric. Food Chem.*, 1954, **2**, 1185—1190).—During open-container storage in the dark, values for peroxides (**I**), monocarbonyl compounds (**II**), and free acids (**III**) remain low during an induction period, and then rise markedly at or just before the appearance of rancid odours; **I** and **II** decrease again to low residual values and rancidity disappears; **III** remains at the higher level. The original moisture contents (11·4 to 12·5%) decrease to ~10% at 77°F., to ~6% at 100°F. and to ~3% at 140°F. **II** maxima occurring after about 1 year at 77°F. are found after about 1 month at 140°F. and 1 week at 180°F. In closed storage at 77° and 100°F. **I** and **II** changes are similar to those during open storage, but the induction period is longer; at 140°F. no increases occur. **III** increase linearly for considerable periods at all three temp. The rancidifying effect of light on fat-containing foods was confirmed for parboiled rice during storage at 77°F. S. C. JOLLY.

Sago flour from Sarawak. R. G. W. Spickett and J. B. Ward (*Colon. Plant Anim. Prod.*, 1954, **4**, 250—254).—The analytical techniques currently used for grading sago flour in Sarawak are described, and the results with eight samples of flour are given. It is suggested that the quality of the flour be recorded on the basis of moisture content, particle size, impurities found on water suspension, viscosity of 2·0% pastes, colour, and odour. G. HELMS.

Corn [maize] production. G. A. Stringfield and M. S. Anderson (*U.S. Dep. Agric. Fmrs Bull.*, No. 2073, 32 pp.).—The importance is stressed of the new hybrid strains in resisting disease and providing an easily-harvestable crop. The climatic requirements, soil treatment, planting technique, storage, and all details necessary to secure a good maize crop by U.S. harvesting standards, are given exhaustively. L. G. L. UNSTEAD-JOSS.

Practical problems in storage, drying, and protection during storage of grain and flour. E. Bernfus (*Mitt. VersuchsSta. Gärungsgew.*, 1954, **8**, 67—75).—A review covering the advantages gained by the use of thresher-reapers, the construction and use of various types of grain-driers, and the protection against pests of stored grain by fumigation and by contact insecticides. P. S. ARUP.

Relative nutritive values of proteins in whole wheat and whole rye and effect of amino-acid supplements. B. Sure (*J. Agric. Food Chem.*, 1954, **2**, 1108—1110).—Based on feeding experiments with albino rats, the proteins of whole rye flour are superior in nutritive value to those of whole wheat flour. Amino-acid supplementation of whole wheat flour gave markedly increased growth responses over those obtained with supplemented whole-rye flour. As rye is more productive than other cereal grains on infertile, sandy, and acid soils, good quality plant protein could probably be grown on many wastelands. S. C. JOLLY.

Wheat products for industrial uses. F. E. Horan (*Trans. Amer. Ass. Cereal Chem.*, 1954, **12**, 258—271).— A review covering industrial methods for separating wheat starch and gluten, and their industrial uses, and a comparison of the composition and properties of wheat and maize starches. (30 references.) P. S. ARUP.

Report of Soft Wheat Subcommittee of Committee on Experimental Milling Procedure. Comparative milling results using silk, nylon, and stainless steel bolting sieves in the Buhler laboratory mill. E. F. Seeborg, H. W. Baker, J. DeHaan, H. K. Heizer, and W. V. VanScoyk (*Trans. Amer. Ass. Cereal Chem.*, 1954, **12**, 300—308).—Collaborative results show the superiority over silk of stainless steel and nylon as bolting materials. P. S. ARUP.

Development of high acidity in wheat flours after storage at normal moisture contents. F. Laustsen (*Trans. Amer. Ass. Cereal Chem.*, 1954, **12**, 280—285).—Comparisons between the titration curves for abnormally acid flours and for normal flour with or without the addition of $CaCO_3$, H_3PO_4, lactic acid, or Ca lactate indicate the abnormal acidity to be mainly due to the presence of lactic acid, with the commonly recognised acid hydrolytic products as contributory factors. P. S. ARUP.

Amylograph standardisation [by] amylograph standardisation committee of the American Association of Cereal Chemists. John A. Johnson (*Trans. Amer. Ass. Cereal Chem.*, 1954, **12**, 292—299).—A progress report embodying a study of the instruments and procedures in use. In comparison with current routine procedures, the tentative standard method described for determining max. η attained by flour and buffer solution mixtures with rise in temp. gives closer agreement between collaborative results. P. S. ARUP.

Viscosity and consistency measurements in bakery. K. H. Winterberg (*Kolloidzschr.*, 1954, **139**, 66—74).—The value of rheological measurements in maintaining and improving the qualities of various doughs, syrups, and coating compositions in bread and cake making is discussed. The influence of variations in the components is considered. The uses of different types of viscometers and extensometers are described. Model experiments are used to test the efficacy of the methods of test. A. B. DENSHAM.

Micro-organisms which reduce the quality of bakers' yeast. L. Heinz (*Mitt. VersuchsSta. Gärungsgew.*, 1954, **8**, 91—94).—A review covering descriptions of moulds and bacteria commonly observed by direct microscopical examination. P. S. ARUP.

Interference by amino-acids in determination of sugars by reductometric methods. R. E. Strange, F. A. Dark, and A. G. Ness (*Biochem. J.*, 1955, **59**, 172—175).—Interference by amino-acids in the reductometric determination of glucose is examined using alkaline Cu and $Fe(CN)_6'''$ reagents. The Cu reagent is appreciably reduced by cystine, tyrosine, and tryptophan, but in general it is less affected by amino-acids than is the $Fe(CN)_6'''$ reagent. Although casein hydrolysate alone has little effect on the Cu reagent, in presence of glucose it interferes, and treatment with $Ba^{\cdot\cdot}$, $Cd^{\cdot\cdot}$, or $Hg^{\cdot\cdot}$ does not substantially decrease the reducing power of a solution of acid-hydrolysed casein. A method is described which uses synthetic cation-exchange resins (IR-120) and which allows accurate determination of glucose in presence of large amounts of amino-acids. J. N. ASHLEY.

Colour measurement and control in the sugar industry. R. A. McGinnis (*Bull. A.S.T.M.*, 1954, No. 201, 42—48).—Methods of measuring the colour of refined-sugar solutions are reviewed critically. Psychophysical, triparameter methods are too complex for routine use, but transmittancies at 560 mμ. are close measures of visual colour (see Brit. Abstr., C, 1951, 382) provided light-scatter is minimised. Very close mechanical filtrations are time-consuming and may remove small amounts of colour, since some compounds contribute both colour and turbidity. The Gillett method, as

standardised by the National Committee for Sugar Analysis [transmittancies of a 50% (wt./vol.) solution measured in 10-cm. cell at 420 and 720 mμ. and corrected for turbidity], gives reproducible values but is of doubtful accuracy because it assumes constancy of colour-absorption curves and uniform turbidants. Measurements at 680 mμ. instead of 720 mμ. would permit most standard photometers to be utilised. W. J. BAKER.

Experimental tests on the diffusion of sugar from beets. G. Nebbia (*Industr. sacc. ital.*, 1954, **47**, 257—260).—Results of tests for the effects of non-ionic, surface-active products—Pluronic F-68, Tween 80, Triton X-100, Ethofat 142/25, and Nonic 218—when added in varying amounts to the water for diffusion in small-scale apparatus, indicated no increase in sugar extraction compared with controls. SUG. IND. ABSTR. (E. M. J.).

Influence of various factors in juice purification on the filtration properties of first carbonation juice. I. W. Dörfeldt and H. J. Delavier (*Z. Zuckerind.*, 1954, **4**, 331—335).—Samples (2 l.) of juices from 14 varieties of beet were each limed with 1%, 2%, or 3% total lime by (*a*) the "standard" of main liming at 80° in 10 min.; (*b*) cold progressive pre-liming at 40° to pH 11·2, a 5-min. pause, main liming at 80° in 10 min.; (*c*) hot progressive pre-liming at 80° to pH 10·9, main liming at 80° in 10 min. The 1st saturation of each sample was at 85° and filtration at 95°. The following values were determined: filtration coeff., filtration time, sedimentation coeff., the muds vol. % after settling for 25 min. and the colour (extinction coeff. at 436 mμ.). Hot pre-liming produced the best filtration and sedimentation behaviour, but no improvement in colour; cold pre-liming caused better filtration than the "standard" and 20% decrease in colour, but rather worse sedimentation values. There was correlation between results of the two filtration test methods and between those of the two sedimentation test methods, but not between filtration and sedimentation characteristics. SUG. IND. ABSTR. (E. M. J.).

Manufacture of raw sugar of high rendement. J. Buriánek and K. Šandera (*Listy Cukr.*, 1954, **70**, 203—205).—By spraying the sugar with just sufficient thick juice of purity 78 to displace (and replace) the green syrup in first raw sugars during centrifuging, it is possible to manufacture "white raw sugars" of compositions approaching that of refined sugars. Even partial replacement of the green syrup gives a higher rendement and less molasses film on the crystals for the refinery to handle. The process causes a 5 to 10% increase in the amount of green syrup (*i.e.*, 0·3—0·6% on beets) and its purity increases by 0·5—2·0, *e.g.*, from 77 to 77·5—79·0. The improved raw sugars do not need affining in the refinery. Large scale tests were carried out in factories, and the rendement could be improved from 92 to 96 or more.
SUG. IND. ABSTR. (E. M. J.).

Influence of inorganic cations on the solubility of sucrose in molasses. —. Quentin (*Zucker*, 1954, **7**, 407—410).—Four samples of the same molasses were treated with suitable cation-exchangers to give molasses in which all other cations present had been largely replaced by Li, Na, K, or Ca in the four samples respectively; the K-molasses was about the same as an average technical molasses. All four samples were adjusted to the same sugar : water ratio and crystallised at 35° in absence of air, or in thin layers at room temp. in air. In the latter case the dry solids slowly increased from 84 to 88%. No crystallisation of Ca salts was found. Polarisation values of the residual mother liquors, suitably diluted, were determined, the lowest per one equivalent of cation being for Li-, Na-, K-, and Ca-molasses, respectively: 170, 235, 252, and 157. Further crystallisation from the molasses was only very slow. The effect of cations on sucrose solubility is indicated in increasing order K, Na, Li, and Ca. SUG. IND. ABSTR. (E. M. J.).

Cube sugar studies. II. Volume, "compactness." G. Vavrinecz (*Élelmezési Ipar*, 1954, **8**, 247—251).—The cubes comprise two sugar phases (crystals and binding layers) and an air phase (the greater part of which is intercommunicating). Values which can be determined are the wt. g, the vol. V, the vol. of the solid part V_s, and the vol. of air $V_1 = V - V_s$, from which can be calculated the sp. gr. of the solid part $= d = g/V_s$, the apparent density $= t = g/V$, and the "compactness" $= T = V_s/V = t/d$. Variations in the cubes are discussed. If the glassy part of the sugar represents 4% of the cube, the average solid phase d is 1·586. The apparent d of the cubes was 1·05 to 1·49 and the compactness 0·63 to 0·945 (mostly 0·75 to 0·82). In average cubes of d 1·2 to 1·3, 75—82% is sugar, 25—18% voids, of which only a small proportion is enclosed.
SUG. IND. ABSTR. (E. M. J.).

Cube sugar studies. III. New methods for determination of apparent density. G. Vavrinecz (*Élelmezési Ipar*, 1954, **8**, 284—287).—Methods of weighing in petroleum or of Hg displacement are discussed. Volokhvyanskii's method is adapted for use with Hg instead of paraffin. The cube is placed in a small strong beaker standing on a level base, over which is placed a stirrup carrying a needle with the tip being $\leqslant 6$ mm. above the cube, and a spring clip to hold the cube in place. Clean Hg is measured into the beaker to the needle point, with and without the sugar present. Possible errors in the determination are discussed. The relation of apparent density of the cube to the time of dissolution had a correlation coeff. of only 0·2 to 0·56. SUG. IND. ABSTR. (E. M. J.).

Strength of cube sugars. H. Érdi (*Cukoripar*, 1954, **7**, 148—152).—A small press is described, designed to measure the pressure at breaking point of the cubes, *i.e.*, the crushing strength. The cubes, polished with glass-paper, or cut to the required size with a small rotary saw are measured accurately. In different sugar samples a small crushing strength was accompanied by a high rate of disintegration on dissolution and the crushing strength decreased with increase in porosity of the cubes.
SUG. IND. ABSTR. (E. M. J.).

Determination of disintegration time of cube sugar. IV. Development of method of examination. G. Vavrinecz (*Cukoripar*, 1954, **8**, 152—158).—The frequency distributions of dissolving times for different samples of cubes varied considerably in type, the regular Gaussian distribution being rarer. According to other experiences, the disintegration time $\propto 1{\cdot}3\sqrt{\text{wt.}}$, and using these values makes the irregular curves more regular, but distorts the regular curves. The use of the median (in wt. of cubes) is recommended, so that only the 8th of a 15-cube sample need be tested. The position of the cube on the "footbridge" holder has no effect.
SUG. IND. ABSTR. (E. M. J.).

Development of acidity and inversion. W. R. McAllep, H. A. Cook, and H. F. Bomonti (*Bol. Ofic. Asoc. Técn. Azucar, Cuba*, 1954—5, **13**, 19—32, 85—92).—Clarified cane juice was heated at 180, 190, 200, and 212°F. The lower the initial pH of the juice the faster was the increase of $H^{\cdot}$ concn. reaching a limit at ~pH 3·5. There was rapid increase with rise in temp. Similar effects were observed on the rate of inversion especially with increase in temp. above 175°F. The results agree well with values calculated by Urech's equation, which is given. Curves of results indicate the conditions of juice treatment which are acceptable, and applications of the data are discussed. SUG. IND. ABSTR. (E. M. J.).

Base-exchangers and evaporator deposits. W. Fivian and U. Manz (*Zucker*, 1954, **7**, 370—372).—Treatment of sugar juices with base-exchangers, replacing Ca by Na does not substantially alter the ash content, and deposits are still formed in the evaporators, though this scale is easier to remove than is $CaCO_3$. Some analyses are given of deposits obtained on evaporation of exchanger-treated juices; these deposits contain 15—25% of volatile components (not further analysed), and analyses are given of the scale after removal of volatile matter by ashing. The SiO_2 contents increase from evaporator 3 to evaporator 6, but the contents of Al_2O_3 and other components vary little. Data from the literature are compared. The compositions appear to depend mainly on the quality of the limestone used as a source of lime.
SUG. IND. ABSTR. (E. M. J.).

Manufacture of levulose from Jerusalem artichoke. J. Yamazaki (*Bull. chem. Soc. Japan*, 1954, **27**, 375—379).—A process for the manufacture of 127 tons of pure levulose (D-fructose) from 6000 tons of artichoke tubers is described. Harvested artichokes are washed, sliced, and dried to 15% moisture, introduced into a series of semi-countercurrent diffusion cells and extracted with hot water. This "diffusion juice" is treated with Cl_2 until a pH of 1·8—2·0 is attained, at 30°, thereby obtaining decolorisation and the precipitation of protein matter etc. Conversion of levulose is effected by keeping the liquor at 80° for 1 hr. The pH is adjusted at 20° to 7·0 by addition of $Ca(OH)_2$ whereby protein and pectin are pptd. After cooling to 0—5°, an excess of $Ca(OH)_2$ is added to produce a granular precipitate of "lime levulate," $C_6H_{12}O_6,CaO,xH_2O$, which in aq. suspension is decomposed by passage of CO_2 until the pH reaches 8·0. The $CaCO_3$ is removed, at $\geqslant 10°$, and the filtrate concentrated to 10% levulose, under vacuum. After neutralisation with oxalic acid or H_3PO_4 to pH 5·8 and filtration, the syrup is further concentrated up to 91% solids, and seeded at 52° with cryst. levulose. Pure levulose is obtained by decolorising the raw material with charcoal, the crystals washed with distilled water and vacuum dried at 40°, giving 99·3% purity. Some analytical procedures, utilisation of waste liquors, and costs are also considered.
G. R. WHALLEY.

Quantitative determination of fructose with skatole and hydrochloric acid. B. M. Pogell (*J. biol. Chem.*, 1954, **211**, 143—147).—Fructose is determined colorimetrically by means of the purple coloration formed when it reacts with skatole in HCl solution. To the fructose solution (1·0 ml.) in an ice-bath is added ice-cold 0·04% skatole (1·0 ml.) and 30% HCl (8·0 ml.). After heating at 37° for 40 min. the colour is read against a water blank at 510 mμ. The colour intensity, which slowly increases with time, shows good

agreement with Beer's law. A reagent blank and a fructose standard are run with each series of determinations. Under the conditions employed other common sugars, except sucrose, do not interfere. C. E. SEARLE.

Quantitative determination of sugars on paper chromatograms by a reflectance method. R. M. McCready and E. A. McComb (*Anal. Chem.*, 1954, **26**, 1645—1647).—A method, utilising direct reflection density measurements on paper chromatograms of the coloured spots developed from reducing sugars with aniline–trichloroacetic acid or fructose and derivatives with acid–recorcinol, is described. The logarithm of the sugar concn. and the reflection density follow a linear relationship over the range 25 to 125 μg. of sugar per spot, using light at 515 mμ. Calibration curves for glucose, galactose, arabinose, and galacturonic and digalacturonic acids are illustrated. The type of paper used is not critical and the most consistent results are obtained when 2·0 to 5μl. of sugar solution are applied to the paper. The method is particularly useful in the determination of pentose mixtures containing uronic acid since orcinol methods do not distinguish between these substances. G. P. COOK.

Pectin : its distribution and properties. I. P. Garrick (*Chem. Prod.*, 1954, **17**, 411—414).—The chemistry and applications of pectin are reviewed with special reference to jelly formulation. The effect of acidity and sugar concn. on jellying power is discussed. G. R. WHALLEY.

Extraction of pectin using ion-exchange resins. M. Morini (*Materie plastiche*, 1954, **20**, 860—862 ; cf. *ibid.*, 440).—Apparatus and technique are described for removal of metallic ions as complexes after precipitation of pectin with $Al_2(SO_4)_3$ and separation of the precipitate. The ppt. is washed with 70% alcohol containing 0·2% HCl, and then with 93—94% alcohol. The last alcohol washing is passed over an anionic resin. By this means, a more concentrated pectin is available. The quality of the product is compared with that of other commercial material. The alcohol washings containing Al are passed through a sulphonated resin (C 300–H, acid form) for recovery of Al and also alcohol. C. A. FINCH.

Effects of skin coatings on behaviour of apples in storage. IV. Comparisons of skin coatings and gas (controlled atmosphere) storage. E. G. Hall and S. M. Sykes (*Aust. J. agric. Res.*, 1954, **5**, 626—648).—With Jonathan apples, gas storage prolonged storage life more than did coatings. With Delicious apples, gas storage was somewhat better than coatings but the gain by either method was small. With Granny Smith variety, coatings were generally more successful than gas storage, probably due to better control of superficial and senescent scalds. Both treatments prolonged storage life primarily by increasing the CO_2 tension and decreasing the O_2 tension inside the fruit. R. H. HURST.

Rapid determination of starch in apples. G. H. Carter and A. M. Neubert (*J. Agric. Food Chem.*, 1954, **2**, 1070—1072).—A rapid colorimetric method is described for determining starch in apples in the maturity range of commercial harvest and storage. The method, which uses the blue coloured starch–iodine complex after a preliminary short digestion with 7·8N-$HClO_4$, depends upon a constant amylose–amylopectin ratio and is accurate for the Jonathan, Golden Delicious, standard Delicious, and Winesap varieties in this range ; 25% of the starch in these varieties appears to be amylose. S. C. JOLLY.

Carbonyl compounds in apple storage volatiles. R. E. Henze, C. E. Baker, and F. W. Quackenbush (*J. Agric. Food Chem.*, 1954, **2**, 1118—1120).—Acetaldehyde, acetone, and propionaldehyde were identified amongst the carbonyl compounds in apple storage volatiles collected on activated C in a commercial refrigerated apple storage ; 15 other carbonyl compounds were separated chromatographically as their 2 : 4-dinitrophenylhydrazones and their absorption spectra are reported. S. C. JOLLY.

Rate of heat-exchange of lemons and oranges packed in standard boxes and in half box fibre board cartons. I. L. Eaks (*Proc. Amer. Soc. hort. Sci.*, 1954, **63**, 279—284).—Fruits at " normal " temperatures were packed in these containers and subjected to cooling and to warming. Lemons and oranges behaved similarly and in the two types of container fruit at the top of the box or carton lost or gained heat at the same rate but the rate of heat-exchange was faster for fruit at the centre of the fibre board carton than for that at the centre of the standard (wooden ?) box. Only in the standard box did fruit at the outside differ in the rate of heat-exchange from the fruit at the centre. The provision of vents in the fibre board container had little or no effect. L. G. G. WARNE.

Quantitative determination of diphenyl in citrus fruits and fruit products by means of chromatostrips. J. G. Kirchner, John M. Miller, and R. G. Rice (*J. Agric. Food Chem.*, 1954, **2**, 1031—1033).—A chromatographic method is described for separating diphenyl from interfering citrus oils, using a heptane extract of the fruit and the chromatostrips of Kirchner *et al.* (*Anal. Chem.*, 1951, **23**, 420), and final determination by visual comparison in u.v. light or by spectrophotometric measurement of the eluted fungicide. The method is applicable in the range 0·1 to 600 p.p.m. S. C. JOLLY.

Quantitative estimation of a bitter principle in tomato fruit. E. A. Borchers and C. S. Nevin (*Proc. Amer. Soc. hort. Sci.*, 1954, **63**, 420—426).—Some lines of tomatoes contain a bitter substance in the fruits which is pptd. by Mayer's reagent (0·05N-KHg iodide). The optical density of an extract after treatment with Mayer's reagent gives an estimate of the amount of the bitter substance present. L. G. G. WARNE.

Effect of various in-plant treatments on quality of processed tomato juice. A. A. Kattan, W. L. Ogle, E. Skolov, and A. Kramer (*51st Ann. Mtg Amer. Soc. hort. Sci., Florida*, 1954, 28).—Reducing the diameter of the screen openings during prep. of juice did not affect the colour of the juice, but allowing the juice to pass twice through the finisher reduced the colour score. Reducing the openings decreased the consistency. Canning tomato juice under CO_2 or N_2 resulted in highest colour scores whilst with O_2 and vacuum the scores were lowest. Consistency was highest with N_2 and air while cold vacuum was lowest. When various pH levels and different processing temp. and periods were applied, the colour score was reduced as the heat unit summations increased. The pH of the juice can be adjusted from 4·4 to 4·0 by addition of citric acid without affecting the flavour. L. G. G. WARNE.

Flavour origin. Flavour and odour components in the tomato. M. S. Spencer and W. L. Stanley (*J. Agric. Food Chem.*, 1954, **2**, 1113—1118).—Vacuum distillation at 20 mm. Hg and solvent extraction followed by molecular distillation of the solvent extract are suitable methods for isolating tomato flavouring constituents. Vacuum distillates from fresh juice contained esters (2), volatile acids (1), and carbonyl compounds (43 p.p.m.) ; for cooked juice the respective figures were 2, 0, and 33 p.p.m. The main carbonyl constituent was acetaldehyde ; *iso*valeraldehyde was also present and probably citral and vanillin. Three different types of tomato odour fractions were isolated chromatographically from the concentrates : (i) a relatively non-volatile typical tomato odour fraction which is largely retained by present processing methods and which contained alcohols, carbonyl compounds, and unsaturated compounds which were modified by many other odour fractions, some terpene in nature ; (ii) a relatively non-volatile green tomato odour fraction ; and (iii) a relatively volatile raw tomato odour fraction. Changes in unsaturated compounds may be involved when the flavour of stored tomato products deteriorates. S. C. JOLLY.

Quality and stability of some tinned creole products. N. Czyhrinciw K. (*Arch. venezol. Nutr.*, 1954, **5**, 133—145).—The products are tomato purée, tomato juice, papaya juice, and bananas in heavy syrup. Total solids and ascorbic acid contents were determined on the samples during storage, together with organoleptic tests. Tentative storage lives under tropical conditions are given respectively, as, 2, 1, 2, 1½ years for the four products named above. L. G. L. UNSTEAD-JOSS.

Ascorbic acid content of canned fruit juices. J. F. Blanchard (*Chem. Can.*, 1954, **6**, No. 11, 41—45).—Analyses of grapefruit, orange, lemon, pineapple, tomato, and apple juice showed a reasonably high average content of ascorbic acid. The range of results for a large no. of samples from different localities is recorded in a table. D. R. PECK.

Cold storage of guavas. K. K. Singh and P. B. Mathur (*Indian J. Hort.*, 1954, **11**, 1—5).—Optimum conditions for the Safeda variety of *Psidium guajava* are 47—50°F. and R.H. 85—90%. Storage life is four weeks and post storage life at 76—87°F. approx. three days. E. G. BRICKELL.

Volatile carbonyl compounds of vegetables and their possible rôle in flavour. O. Silberstein (*Proc. Amer. Soc. hort. Sci.*, 1954, **63**, 359—370).—Vegetables were autoclaved at 15 lb. pressure and then distilled and the distillate collected in a solution of 2 : 4-dinitrophenylhydrazine hydrochloride and any resulting hydrazones generally studied by paper partition chromatography. Peas yielded chiefly acetaldehyde with possibly a methyl *iso*propyl ketone derivative, and furfural. Unidentified compounds were also present. The chief compound obtained from onions was propionaldehyde, and from sweet corn acetaldehyde together with (probably) formaldehyde derived from the cob. L. G. G. WARNE.

Comparison of the tenderometer and maturometer for measuring the quality of raw peas. C. B. Sayre (*Proc. Amer. Soc. hort. Sci.*, 1954, **63**, 371—377).—The tenderometer measures the resistance to a shearing force of two grids and the maturometer the mass resistance of 143 peas to puncture by steel rods. Readings from the two instruments show a high positive correlation and both are correlated

with the per cent alcohol-insol. solids in the peas. Maturometer readings on duplicate samples are generally more variable than tenderometer readings. L. G. G. WARNE.

Effect of modified atmospheres on respiration and yellowing of broccoli at 75°F. M. Lieberman and R. E. Hardenburg (*Proc. Amer. Soc. hort. Sci.*, 1954, **63**, 409—414).—Atmospheres containing 1—10% O_2 reduced the rate of CO_2 evolution of broccoli at 24°, but 100% N_2, whilst it reduced respiration, caused tissue injury in two days. In closed containers with atmospheres initially as above, damage occurred much sooner than when the gas mixture was passed over the broccoli and most of the O_2 in the closed container was utilised in one day. Yellowing was completely stopped in an atmosphere of N_2 and greatly reduced if the atmosphere was low in O_2 (1%) or high in CO_2 (7—22%). The yellowing may be caused by ethylene produced under aërobic conditions. L. G. G. WARNE.

Starch from *Ipomea batata*. M. A. Aziz and M. Mohsin (*J. Indian chem. Soc., Industr. News. Edn*, 1954, **17**, 123—126).—Preservation of starch in sweet potatoes can be achieved by reducing the water content to 0·5% and thereby checking enzyme activity. Development of browning on cut fruits cannot be prevented by checking enzyme activity, by treatment with 5% NaCl, KI, or KCl, or by treatment with 10% H_2SO_4 or HCl, but is completely checked (two months' storage) by 10% acetic acid. The enzyme from *Aspergillus oryzæ* exerts its max. activity at 60° and pH 4·8 and then converts 11% of the starch into glucose. G. HELMS.

Snap beans for marketing, canning, and freezing. W. J. Zaumeyer (*U.S. Dep. Agric. Fmrs Bull.*, No. 1915, 16 pp.).—The cultivation of snap beans (runner beans) in the U.S. is described exhaustively under headings such as adaptation, soil conditions, varieties, planting technique, diseases, and pests. L. G. L. UNSTEAD-JOSS.

Dietary values of Central American foodstuffs. I. Tubers, roots, green vegetables, and fruits. G. Arroyave, S. Pizzati, R. Bressani, and J. Méndez (*Arch. venezol. Nutr.*, 1954, **5**, 61—70).—The moisture content, ether extract, crude fibre, N, ash, Ca, P, carotene, thiamine, riboflavin, ascorbic acid, and niacin contents of 72 samples of tubers, roots, green vegetables, and fruits from Central America, are tabulated. L. G. L. UNSTEAD-JOSS.

A study of ascorbic acid oxidase and associated enzymes. R. A. Kulkarni and A. Sreenivasan (*J. sci. industr. Res. India*, 1954, **13, B**, 606—609).—The activities of ascorbic acid oxidase, polyphenol oxidase, and peroxidase systems were measured in a Warburg manometric apparatus, using single side-arm type reaction vessels. Enzymes of cucumber, drumstick, and potato were employed, and were obtained by precipitation with ammonium sulphate or acetone or by dialysis against water. Results of adsorption on alumina gel and inhibition with S compounds and cyanide are given. The activities of heated extracts and of ionic Cu are compared. The functions of the three types of oxidase in the plant tissue can be dissociated and studied independently. (21 references.) G. C. JONES.

Effect of terpineol in inhibiting the sprouting of potato tubers during storage. P. M. Mathur and H. C. Srivastava (*Bull. Centr. Food technol. Res. Inst., Mysore*, 1954, **3**, 271—272).—The physiological loss in wt. and sprouting of 25-lb. lots of potatoes stored for 22 days in gunny bags at 52—55°F. (R.H. 85—90%) were considerably reduced by distributing strips of filter paper soaked in terpineol uniformly throughout the bag. At higher temp. the treatment was less effective. S. C. JOLLY.

Grist, mashing procedure, and brewing yields. P. Kolbach (*Mschr. Brauerei, wissensch. Beil.*, 1954, **7**, No. 9, 99—103).—A review showing the primary influence on yields of the degree of fineness of grinding of the malt, and of thorough mashing, and the relative unimportance of boiling. P. S. ARUP.

Evaluation of malt. Relation of α-amylase and limit dextrinase of barley malt to production of ethyl alcohol from grains. K. Whitehouse and S. L. Adams (*J. Agric. Food Chem.*, 1954, **2**, 1040—1043).—The suitability of a malt for grain saccharification may be ascertained rapidly from either α-amylase (**I**) or limit dextrinase (**II**) contents. The reciprocals of **I** and **II** correlated well (−0·847 and −0·800, respectively) with alcohol production from grain starch. S. C. JOLLY.

Brewing value of malt. II. K. Fuss (*Brauwissenschaft*, 1954, No. 11, 244—245).—The difference between extract yields from finely and coarsely crushed malt is an unreliable criterion of the brewing value. A shortened form of the Hartong method and the use of the Brabender hardness tester for testing the friability of the malt are recommended. Observations on the increase of the refractometric d and the η of the wort in the Congress mash are recorded. P. S. ARUP.

Infection of wort. J. Ernst (*Brauer u. Mälzer*, 1954, **7**, No. 17, 15—16).—Various cases are described of wort infections occurring during passage to the cooler or on the cooler, which were due to corroded parts, inadequate cleaning, or to infections from the air or from dripping condensate. Suitable measures for preventing such infections are described. P. S. ARUP.

Infections of short-rod bacteria in beer. U. Hoffmann (*Brauwissenschaft*, 1954, No. 11, 234—238).—Short-rod sediment-forming bacteria have recently been of frequent occurrence in beer, but cultural difficulties prevent their isolation by routine methods from morphologically similar harmless organisms. The beer sediments contain, besides single rods, binary and quaternary cell-aggregates of rods, cocci, or (mixed) rods and cocci in various configurations, including typical *Sarcina* forms. Evidence is given indicating the possibility of transitions between coccus and rod forms, and the problem is discussed in relation to the literature. P. S. ARUP.

Comparison of various nutrient solutions for detection of spoilage organisms in pitching yeast. H. Füsser (*Brauwelt*, 1954, **B**, 1167—1170).—The use of enrichment media is essential. Quicker results (within 1—2 days) are obtained with wort media (especially with the addition of yeast-water), pasteurised beer with yeast-water, or yeast-autolysate than with the Betges–Heller medium (with or without yeast-water), but better distinction between spoilage and harmless infections is obtained with the Betges–Heller medium. Examples are given, showing how satisfactory information can be obtained by liberal inoculation of the yeast sample into two or more of the above media. A rapid fall in pH is always an unfavourable indication. P. S. ARUP.

Factor influencing the yeast fermentation methods for [determining] thiamine and pyramin. W. O. Caster and O. Mickelsen (*J. Agric. Food Chem.*, 1954, **2**, 1073—1076).—Accurate determination of thiamine and pyramin is important in the nutritional and clinical study of vitamin-B_1 metabolism because pyramin is a breakdown product of thiamine. Several clinical and physical factors can affect the accuracy of the A.O.A.C. methods and several modifications are suggested. (16 references.) S. C. JOLLY.

Judgment of brewing value of hops by external characteristics. B. Mändl (*Brauwelt*, 1954, **B**, 1143—1146).—A review covering characteristics to be noted in the inspection of hops. P. S. ARUP.

Physiologically active constituents of hops. F. Knorr (*Brauwelt*, 1954, **B**, 1149—1151).—A review covering recent investigations on the bacteriostatic, fungistatic, and tuberculostatic properties of the various constituents of hop bitters, and on the chromatographic separation of hop constituents. Curtailing of the boiling-time in order to minimise the decomposition of humulone and lupulone is more important than attempting to secure max. extraction by prolonged boiling. (17 references.) P. S. ARUP.

Hop-bitters in beer. F. Knorr (*Brauer u. Mälzer*, 1954, **7**, No. 15, 10—12).—A review covering the bitter constituents of hops, and the changes which they undergo during the ageing of hops and during hop-boiling and brewing; recent procedures for economising hops are mentioned. P. S. ARUP.

Use of audible sound vibrations in hop-boiling. W. Kleber (*Brauwelt*, 1954, **B**, 1213—1215).—The Ultrakust Sonator Ho 200 emits vibrations at 100 Hz. with a consumption of 700 w., the vibrator being immersed in the wort during hop-boiling. Experiments are described in which the use of the apparatus effected a saving of 20% in hops, with moderate gains in the bitter content of the beer. The bitter content of the wort after boiling afforded no guide as to that of the resulting beer. The use of the apparatus causes no damage to plant, or other inconvenience. P. S. ARUP.

Methods for beer filtration. F. Knorr (*Brauer u. Mälzer*, 1954, **7**, No. 19, 13—16).—A review covering descriptions of various types of filtering material, their preparation, applications and effects, membrane filtration, and clarification by means of the centrifuge. P. S. ARUP.

Biological problems in bottling cellar. H. Willmar (*Brauwelt*, 1954, No. 88, **B**, 1315—1318).—A review covering types of infection from various sources, the use of disinfectants in bottle-cleaning, conditions for ensuring sterile bottling, and the promotion of biological stability by ordinary or short-time pasteurisation, or by EK (sterilising) filtration. P. S. ARUP.

Determination of carbon dioxide, oxygen, and nitrogen in bottled beer. E. Paukner (*Brauwelt*, 1954, No. 83, **B**, 1237—1243).—The Stadler and Zeller apparatus (cf. *ibid.*, 1950, 569) for determining the pressure and contents of the above gases is described in detail. The principles and practice of the procedure are explained with the help of examples, including the calculation of the vol. of air enclosed in the bottle at the time of closure. Solubility data are given for CO_2, O_2, and N_2 in beer. P. S. ARUP.

Determination of colloidal stability of beer. O. Schmied and F. Huber (*Mitt. VersuchsSta. Gärungsgew.*, 1954, **8**, 79—82).—Export bottled beer is satisfactorily tested for colloidal stability by a standard procedure in which the effect on nephelometric data of alternate shaking at 40° for 48 hr. and cooling to 0° for 3 hr. is observed. The shaking treatment is designed to simulate conditions obtaining in practice. Other tests include determinations of pptn. limits by $(NH_4)_2SO_4$ or the Esbach reagent, of air contents, and of ITT values, and protein fractionation by Lundin's method. (20 references.) P. S. ARUP.

Microbiological method for detection of preservatives and antibiotics in bottled beers. D. A. A. Mossel (*Ann. Falsif., Paris*, 1954, **47**, 349—357).—A fermentation method using baker's yeast is described for the detection of preservatives and antibiotics added to beer at the levels normally used in practice. S. C. JOLLY.

Solubility of malt in relation to paper chromatography. M. Lindemann (*Brauwissenschaft*, 1954, 185—189).—Preliminary experiments on the qual. chromatographic analysis of laboratory worts for amino-acids and sugars gave an insight into the changes undergone by the proteins and carbohydrates during malting, but failed to afford a satisfactory means for determining malt solubility. (25 references.) P. S. ARUP.

Importance of paper chromatography in brewing technological research. I. Technique. A. Stöckli (*Schweiz. Brauerei Rdsch.*, 1954, **65**, No. 9, 139—144).—Descriptions are given of the principles of one- and two-dimensional chromatography, and of a technique in which the unsprayed spots including incompletely separated constituents are separately cut out and sewn on to new paper strips for development with respectively suitable solvent mixtures. An example is given of the separation of a mixture of 22 amino-acids. P. S. ARUP.

Importance of paper chromatography in brewing technological research. II. Significance. A. Stöckli (*Schweiz. Brauerei Rundsch.*, 1954, **65**, 175—178; cf. *ibid.*, 139).—A review of recent literature demonstrating the practical value of determinations of the components of wort and beer by means of paper chromatography. (21 references.) P. S. ARUP.

Influence of excess pressure of carbon dioxide during fermentation on alcohol yield, rate of fermentation and reproduction of yeast. B. Drews, F. Just, and B. Matzik (*Mschr. Brauerei, wissensch. Beil.*, 1954, **7**, 111—117).—Excess pressures of 0·1—0·4 atm., due to CO_2, do not affect the course of fermentation as regards rate, extent, and yield of EtOH, but reduce yeast reproduction. At 20 atm. excess pressure, the inhibition of yeast growth is complete, but the EtOH production, based on wt. of yeast, increases with increasing pressures up to 10 atm., after which it rapidly declines. The inhibition of fermentation is due to high concn. of CO_2, and not to pressure *per se*. Removal of CO_2 by bubbling N_2 or air through the fermenting liquid promotes fermentation and yeast growth; bubbling CO_2 produces similar, but less marked effects. Laboratory pilot plant experiments indicate that appreciable amounts of EtOH can be recovered by washing the escaping CO_2 with water. P. S. ARUP.

[A] **Acceleration of alcoholic fermentation by products of protein decomposition.** A. G. Sabrodski and N. S. Kordjukowa. [B] **Viability of yeast in presence of products of protein decomposition.** A. G. Sabrodsky and S. S. Lestschinskaja (*Mikrobiologiya*, 1954, **23**, 57—63, 313—317; *Mitt. VersuchsSta. Gärungsgew.*, 1954, **8**, 75—79, 94—96).—(A) The view that the observed superior fermentability by yeast of defective as compared with normal maize (in mashes) is due to the presence in the former of protein decomposition products which stimulate yeast growth is confirmed by the increased fermentability of normal maize observed (*a*) on raising the temp. at which the mash is autoclaved, (*b*) on keeping the mash for 16 hr. at 45—60° (but not at 80°) before cooking, and (*c*) on adding asparagine to the mash.

(B) In comparison with yeast cultivated in mash from normal maize, yeast cultivated in defective maize mash is healthier, and shows more vigorous growth and fermenting capacity, with a greater proportion of dead cells after each fermentation. P. S. ARUP.

Simple method for testing and controlling biological filtration effect of kieselguhr filters. W. Kleber and U. Hoffmann (*Brauwelt*, 1954, **B**, 1125—1127).—The "Filtrox control-filter" consists in a miniature membrane-filter (the construction and operation are described) which can be coupled to a side-tube in the draw-off pipe of the kieselguhr filter. About 200—500 ml. of the beer are passed through the apparatus during 10—30 min., and the sediment on the membrane is examined microscopically for yeast. Alternatively, the membrane may be placed with the underside in contact with wort-agar in a Petri-dish, and examined for yeast colonies after incubation at 25—28° for 36—48 hr., or the membrane may be stained with methylene-blue, washed, dried and examined under low-power magnification, and preserved for reference. P. S. ARUP.

Colour methods in the brewing industry. I. Stone (*Bull. A.S.T.M.*, 1954, No. 201, 40—42).—An improved physical definition of the intensity of beer colour and a new photometric method of measuring colour values of beer samples are given. The method involves measurement of the light absorption of a sample of 0·5 in. thickness at 430 mμ., either by a Beckman DU spectrophotometer, in which case the colour value is calculated directly from the reading, or by filter or other photometers previously calibrated using standard colour values obtained with a Beckman instrument. The procedure eliminates eye-fatigue error inherent in the visual matching methods. W. J. BAKER.

Detection of traces of artificial colours in wine. E. Portal and J. Bonastre (*Ann. Falsif., Paris*, 1954, **47**, 341—345).—An improved method is described for the detection and estimation of added artificial colours in wine, based on a double adsorption of the colour on wool in acid solution. Natural colouring matters do not interfere. S. C. JOLLY.

Comparison of various methods for the determination of aldehydes in brandy. J. Lafon and P. Couillaud (*Ann. Falsif., Paris*, 1954, **47**, 357—372).—Factors affecting colour development in a no. of colorimetric methods for determining aldehydes have been examined, and an improved method, suitable for control purposes, is described for determining aldehydes in brandy. S. C. JOLLY.

Chromatographic determination of glutamic acid in distillery residues. F. Parisi and G. Funes (*Chim. e Industr.*, 1954, **36**, 684—692).—The material is hydrolysed with HCl, the diluted hydrolysate is passed through an acid Duolite C-3 resin column, which is washed with 3% aq. NH_3, the eluate is adsorbed on acid Al_2O_3, which is washed and eluted with 6% aq. NH_3. The glutamic acid in the eluate is determined by ascending paper chromatography, solvent 50 : 35 : 15 pyridine–acetic acid–water, developing with ninhydrin, and comparing the intensity of the spots with those given by standard concn. of glutamic acid. Values found for different samples varied from 6·5 to 11·8%. R. TRUSCOE.

Rapid method for the estimation of copper in cider. C. F. Timberlake (*Chem. & Ind.*, 1954, 1442—1443).—Acidified (1N.) cider is extracted with a CCl_4 solution of Zn dibenzyldithiocarbamate in a centrifuge cup. The optical density of the clarified bottom layer is determined and the Cu present is found by reference to a standard graph. The extraction may be carried out in a separating funnel or test tube with the addition of acetone. If a spectrophotometer is not available Cu may be estimated visually by comparison with standard $K_2Cr_2O_7$ solutions. The method is only suitable for cider free of deposit or suspended matter. A. M. SPRATT.

Quinic acid metabolism in cider fermentation. J. G. Carr, J. D. Phillips, A. Pollard, G. C. Whiting, and A. H. Williams (*Chem. & Ind.*, 1954, 1515—1516).—Pure cultures of lactic acid bacteria (closely resembling *Lactobacillus brevis* Orla-Jensen (Bergey *et al. Manual of Determinative Bacteriology*, 6th Ed., 1948)] in a medium containing yeast extract casein hydrolysate, fructose and quinic acid at pH 4·2 on incubation for 12 days at 25° under conditions of reduced oxygen tension, followed by fractional elution from ion-exchange resins, give an acid $C_7H_{12}O_5$, identified as the dihydroshikimic acid of Grewe and Lorenzen (*Chem. Ber.*, 1953, **86**, 928) with the position of the carboxyl group corresponding to that in (−)-quinic acid. I. JONES.

Determination of monobromoacetic acid and its esters in beverages. G. Curli and V. Prati (*Chim. e Industr.*, 1954, **36**, 704—705).—The standard method (Florentin *et al., Ann. Falsif., Paris*, 1936, **29**, 104) gives only 10—35% recovery, the losses being ascribed to volatilisation of $CH_2Br{\cdot}CO_2H$ and its Et and benzyl esters during extraction and hydrolysis. Minor modifications are suggested, which give slightly less than theoretical results for beverages containing about 2 mg. of org. Br per l. R. TRUSCOE.

Factors affecting the nutritive value of cow's milk. J. N. Bixby, A. J. Bosch, C. A. Elvehjem, and A. M. Swanson (*J. Agric. Food Chem.*, 1954, **2**, 978—982).—Using albino rats as test animals, the nutritive value of cow's milk is unaffected by season, pasteurisation or homogenisation. Young rats, however, maintained on a mineralised milk diet accumulate excess fat in their livers. This fatty liver condition correlated with butterfat content of the diet, but was not related to season, pasteurisation, or a deficiency of several well-known lipotropic factors. (25 references.) S. C. JOLLY.

[**Microbiological assay of**] **essential amino-acids in the milk of Indian buffalo.** N. V. Joshi and H. Raj (*Indian J. Dairy Sci.*, 1954, **7**, 139—146).—Assays were carried out on the acid-hydrolysed

casein, prepared from the milk and freed from fat and unsaponifiable matter, using the method of Barton-Wright (*Analyst*, 1946, **71**, 267). Recoveries for the various acids ranged from 93 to 104·5%, and no difference was observed when assays were carried out by the above method or by the method as modified by Barton-Wright and Curtis (*Analyst*, 1948, **73**, 330). The amino-acid composition of buffalo milk protein is remarkably similar to that of cow's milk protein. The results confirm previous findings. L. G. L. UNSTEAD-JOSS.

Effect of storage temperatures on the growth of psychrophilic organisms in sterile and laboratory pasteurised skim milks. W. C. Lawton and F. E. Nelson (*J. Dairy Sci.*, 1954, **37**, 1164—1172).—So-called low-temp. organisms can grow rapidly at higher temp. and can make significant contributions to total plate counts made at 32° or below. Of 8 strains isolated from pasteurised milk by plating out and storing at 3°, 7 were *Pseudomonas* and *Flavobacterium* sp. Temp. for optimum growth is generally about 21—32°.
S. C. JOLLY.

Tallowiness in milk powder. J. T. C. Van den Berg (*Conserva*, 1954, **3**, 135—138).—A review covering the causes and prevention of the defect. P. S. ARUP.

Some factors affecting the action of benzoyl peroxide in the bleaching of milk and cream for Blue cheese manufacture. S. Kuramoto and J. J. Jezeski (*J. Dairy Sci.*, 1954, **37**, 1241—1246).—Using 50% carotenoid loss as the end-point, cream for Blue cheese manufacture can be sufficiently bleached, without the formation of objectionable and tallowy flavours, by treatment at 125° to 145°F. for 90—120 min. with 0·0009% of benzoyl peroxide. Decolorisation was more effective the higher the fat content of the cream. Regardless of the original carotenoid level of raw cream, similar proportions of carotenoids were destroyed by a given concn. of benzoyl peroxide.
S. C. JOLLY.

Protein hydrolysis. II. Use of sulphurous acid for the control of humin formation and loss of tryptophan during acid hydrolysis. J. W. Pedersen and B. E. Baker (*J. Sci. Food Agric.*, 1954, **5**, 549—556).—Using H_2SO_3 alone to hydrolyse casein, lactalbumin, ovalbumin, and fibrin to 34—37% of complete hydrolysis, tryptophan losses were 0—3%; using N-H_2SO_4 with H_2SO_3 to give 65—70% of complete hydrolysis, these losses were 2—10% of the total. For effective preservation of tryptophan, 10 and 15 g. of SO_2 per 100 ml. of N-H_2SO_4 and N-HCl, respectively, were required. Preliminary rat feeding tests indicated that a H_2SO_3—H_2SO_4 casein hydrolysate would support growth and is not grossly toxic. S. C. JOLLY.

Flavour origins. Review of chemical mechanisms affecting flavour acceptability of dairy products. D. V. Josephson (*J. Agric. Food Chem.*, 1954, **2**, 1182—1185).—An address reviewing present knowledge on the chemical mechanisms affecting the flavour and odour of milk and processed milk products. (17 references.)
S. C. JOLLY.

Efficient laboratory freeze-drying apparatus. A. L. Tappel (*Anal. Chem.*, 1954, **26**, 1671—1672).—A freeze-drying apparatus is described which can be made from generally available laboratory equipment. It is convenient in use as the sample is visible, the sample temp. and total pressure are measured, and only one vacuum seal is broken in opening the freeze-dryer vacuum chamber. With the apparatus a 1-in. thick beefsteak can be freeze-dried to 10% moisture in approx. 24 hr. J. H. WATEN.

Biochemistry of myoglobin. I. Quantitative determination in beef and pork muscle. I. D. Ginger, G. D. Wilson, and B. S. Schweigert. **II. Chemical studies with purified metmyoglobin.** I. D. Ginger and B. S. Schweigert (*J. Agric. Food Chem.*, 1954, **2**, 1037—1038, 1039—1040).—I. A colorimetric method is described for the determination of myoglobin (**I**) as cyanometmyoglobin in animal muscle. The **I** content of beef muscle is almost five times that of light-coloured and almost three times that of dark-coloured pork muscle.

II. Based on light absorption studies the conversion of purified metmyoglobin (Fe^{***}) prepared from beef muscle to **I** (Fe^{**}) by reduction with ascorbic acid was little affected by pH (7·0 or 5·8). **I** was converted to nitric oxide myoglobin in < 5 min. by $NaNO_2$ at pH 5·8. S. C. JOLLY.

Amino-acids in edible animal proteins. S. B. Sarkar and C. R. Raha (*J. Indian chem. Soc., Industr. News Edn*, 1954, **17**, 138—140).—Two-dimensional paper chromatography was used to examine the amino-acid components in protein hydrolysates of casein, goat, beef, turtle, and 14 marine fish. Almost all the essential amino-acids were present in each case. Tryptophan was absent probably owing to decomposition during strong acid hydrolysis.
G. HELMS.

Preservation of fish by freezing and icing. G. Oppert (*Kältetechnik*, 1954, **6**, 274—278).—Freshly caught fish were cooled in an air stream to an internal temp. −25°, and then iced by dipping in fresh water n times for periods increasing up to x sec. Values of n and x necessary to build a suitable ice coating depend on the size and shape of the fish (dimensions of 11 species are given). Usually n = 1—3 and x = 4—12 sec. A. R. PEARSON.

Changes in fish during storage and spoilage. A. F. M. G. Luijpen (*Conserva*, 1954, **3**, 164—167).—A review covering microbiological, enzymic, and chemical spoilage, products and effects of spoilage, and methods of preservation and (for pickled herrings) of ripening. (25 references.) P. S. ARUP.

Stability of hydrogenated groundnut oil (Vanaspati). B. R. Roy (*J. Indian chem. Soc., Industr. News Edn*, 1954, **17**, 90—96).—The storage stabilities of crude, refined, and hydrogenated groundnut oils are compared. Crude oil is more stable than refined oil; the preservative action of ethyl gallate is greater with the refined oil. With neutralised oils of varying acidity before neutralisation, the oils with low initial acidity were the more stable and were better protected with ethyl gallate. Hydrogenated oils are more stable than non-hydrogenated oils; inclusion of 5% refined sesame oil accelerates deterioration, whereas inclusion of 5% refined hydrogenated oil affords some protection. G. HELMS.

Effect of citric and tartaric acids on the stability of crude refined and hydrogenated groundnut oils. B. R. Roy (*J. Indian chem. Soc. Industrial News Edn*, 1954, **17**, 135—137).—0·01% of each acid, singly and together, was used to preserve oil stored in loose-covered gas jars at 37°. Peroxide values and acid values were determined monthly. Efficiency of protection was of equal order with the two acids separately and there was some synergistic effect when both were used. The crude oil was better protected than the hydrogenated oil.
G. HELMS.

Seed fat of *Omphalea queenslandiæ*. H. H. Hatt and A. Z. Szumer (*J. Sci. Food Agric.* 1954, **5**, 534—536).—Large seeds of *O. queenslandiæ* contain about 28% of an edible, semi-drying oil. Its component glycerides consist almost entirely of those of the four common fatty acids, which in one example were present in the proportions: palmitic 12·7, stearic 8·1, oleic 47·0, and linoleic 31·7%. The composition of the oil is variable. S. C. JOLLY.

Estimation of argemone alkaloids by the colorimetric silicomolybdic acid method. A. C. Roy (*J. Indian chem. Soc., Industr. News Edn*, 1954, **17**, 141—146).—The toxic alkaloids sanguinarine (*S*) and dihydrosanguinarine (*DS*) present in argemone oil (an adulterant of mustard oil) can be estimated quantitatively by colorimetry, by pptn. with silicomolybdic acid and determination of the Mo as the thiocyanate in a Spekker absorptiometer. The method is applied to the estimation of alkaloids in argemone oil, after HCl extraction. *DS* is converted into *S* by shaking with $FeCl_3$ and the silicomolybdate technique applied. The average of several estimations on argemone oil gave a content of 9·46 mg. *S* per g. of oil. The method can be used for assaying as little as 0·02 g. or argemone oil pure or mixed with mustard oil, and is reasonably accurate in estimating 0·2 to 50 mg. of *S* hydrochloride.
G. HELMS.

Antioxidants during frying of fat. V. H. Kapadia and N. G. Magar (*J. Indian chem. Soc., Industr. News Edn*, 1954, **17**, 101—104).—The antioxidants propyl gallate, di-*tert.*-butyl-*p*-cresol, nordihydroguaiaretic acid (NDGA) and butylated hydroxyanisole are destroyed at around 200° and hence become ineffective when preserved fats have been used for frying. G. HELMS.

Progress in feed quality control. M. L. Cooley (*Trans. Amer. Ass. Cereal Chem.*, 1954, **12**, 285—291).—A review covering recent improvements in established analytical methods, and methods for determining inorg. elements, vitamins, antibiotics, and (in medicated feeding stuffs) drugs. (14 references.) P. S. ARUP.

Recent knowledge of vitamin B_{12}. W. G. Jaffé and O. L. Gómez (*Arch. venezol. Nutr.*, 1954, **5**, 71—88).—Recent discoveries concerning the structure, microbiological assay, distribution, requirements for the rat and hen (2μg. per kg. of solid diet), absorption, biochemical effects, and anti-anæmic action of vitamin B_{12}, are summarized. Its interrelation with other vitamins, and the effects of its deficiency are referred to. (45 references.)
L. G. L. UNSTEAD-JOSS.

Influence of processing on supplementary value of vitamin B_{12} and amino-acids to protein in whole wheat. B. Sure (*J. Agric. Food Chem.*, 1954, **2**, 1111—1113).—The greatest influence of vitamin B_{12} in increasing protein efficiency of processed wheat (commercial shredded wheat) occurred in the presence of lysine and threonine. When fed at 7% protein level to albino rats, addition of 0·1 μg. of vitamin B_{12} per animal per day with 0·4% of lysine and 0·2% of DL-threonine increased protein efficiency by 42·1%; when fed supplemented untreated wheat the increase was only 14·1%. It may become economically possible to incorporate amino-acids in cereal breakfast foods. S. C. JOLLY.

Application of potentiometric rotary viscometer to measuring consistency of food purees and pastes. R. J. McColloch and E. A. Beavens (*J. Agric. Food Chem.*, 1954, **2**, 986—990).—The instrument described for measuring the consistency of food products gives results that agree well with subjective assessments. The apparatus largely overcomes problems associated with the heterogeneous and thixotropic nature of pastes and purees. S. C. JOLLY.

Apparatus for the determination of small amounts of sulphur dioxide in food products by Grant's method. J. Penasse and H. Cheftel (*Ann. Falsif., Paris*, 1954, **47**, 345—346).—A convenient apparatus is described for use in the method described by Dupaigne (*ibid.*, 1951, **41**, 111) for determining small amounts of SO_2 in food products. S. C. JOLLY.

Spray reagent for the identification of certain organic acids in paper chromatography. P. Godin (*Chem. & Ind.*, 1954, 1424).—A reagent made immediately before use by mixing pyridine (7 vol.) and acetic anhydride (3 vol.) is sprayed on to the dried chromatogram. This gives a brown-yellow spot for *cis*- and *trans*-aconitic acids, a brown spot for fumaric acid, a pale yellow spot for itaconic acid, and a yellowish spot for citric and *iso*citric acids. These spots become darker if the chromatogram is placed in an oven at 80—90° for 2—3 min. Nineteen common acids do not react. A. M. SPRATT.

Apparatus for the aseptic removal for analysis of the gas contained in a can of preserves. G. Thomas and H. Cheftel (*Ann. Falsif., Paris*, 1954, **47**, 347—349).—A small apparatus is described which allows the withdrawal of gas for analysis from the can without contaminating the contents and its replacement by sterile air. S. C. JOLLY.

Pesticide residues in foods. Dichlorodiphenyltrichloroethane and dichlorodiphenyldichloroethylene content of prepared meals. Kenneth C. Walker, M. B. Goette, and G. S. Batchelor (*J. Agric. Food Chem.*, 1954, **2**, 1034—1037).—Very small but detectable amounts of DDT and its metabolite dichlorodiphenyldichloroethylene (DDE) were found in 25 typical meals from restaurants and institutions in Washington, U.S.A.; the amounts were not considered a toxicological health hazard. Amounts of DDT were highest in fried foods and in those having a high fat content, either natural or added. S. C. JOLLY.

Preservation of foods. V. General considerations. H. A. Leniger (*Conserva*, 1954, **3**, 173—182).—A review covering spoilage factors and methods for preservation. P. S. ARUP.

Metal containers for food. J. G. Huntley (*Chem. & Ind.*, 1954, 1434—1437).—Among the more recent advances in the manufacture of tins for foodstuffs are the production of electrolytic tin-plate, the use of a Pb solder containing only 2—3% of Sn, the development of interior and exterior lacquers and of a liquid lining compound to make the double seam at either end of the tin airtight. Untinned steel and Al cans are less widely used. Current developments are chiefly concerned with resistance to corrosion by the atmosphere or the contents. A. M. SPRATT.

Grain cleaner. William J. Freeman (B.P. 715,516, 21.5.52).—The machine consists of a casing housing two spaced horizontal rotatable cylinders one above the other. One cylinder has longitudinal corrugations on its inner surface and transverse partitions dividing each of the corrugations into pockets. The other cylinder has longitudinal corrugations on its inner surface. Adjustable stationary catch pans are mounted centrally in each of the cylinders to collect material carried up by the pockets and corrugations. Grain is fed to the upper cylinder first and this then passes to the lower one from which clean grain is dropped into the catch pans. Grit etc. is discharged from the lower cylinder. J. W. MULLIN.

Decorticator for hulling grain. E. Grimard (B.P. 713,986, 25.3.52. Belg., 27.4.51).—A vertical tower contains a central upright rotating column carrying rows of arms with rubbing members in the form of pegs and blades, baffles being placed between the rows so that the grain has to pass into the centre then out to the periphery, the arms sloping upwards from the centre. K. RIDGWAY.

Treatment of cereals. Research Ass. of British Flour Millers (Inventor: Hylton F. Martin) (B.P. 715,943, 17.10.50 and 7.3.51).—The object is to prevent the development of rancid flavours in groats (hulled oats) and loonzain (hulled rice) by inactivating the enzyme lipase present naturally in an acid-permeable layer in the grain. The grain is mixed with aq. HCl or H_2SO_4 at pH ~1, at normal temp. for about 20 min. The pericarp can be removed before or after acidification. The grain is then centrifuged, washed with water and given a dil. alkaline wash and then dried. About 1·5 to 2% of the initial dry weight of the grain is lost. J. W. MULLIN.

Fractionation of starch. Cooperatief "Aardappelmeelverkoopbureau" der Vereenigde Boerenfabrieken (B.P. 713,899, 19.6.52. Neth., 22.6.51).—A solution of starch $\gtrsim$5 (or $\gtrsim$1·5)% in water is cooled *e.g.* to 45—50 (or 20—35)°, then amylose in substantially pure form is precipitated therefrom by addition of a suitable org. compound, *e.g. iso*pentyl alcohol (2—2·5), *sec.*-octyl alcohol (0·035), or $COPr^i_2$ (0·6 vol.-%). F. R. BASFORD.

Conversion of starch and other polysaccharides. K. K. K. Kroyer (B.P. 715,425, 11.7.52. U.S., 17.7.51).—In an improved process involving less labour, starch material (*e.g.*, a starch slurry *d* 1·1983 containing 0·06 wt.-% of HCl) is converted into dextrose-containing product (glucose) by continuously pumping (at a rhythmically varying velocity) through a tubular heater (while subjecting to kneading or stirring) and then a tubular converter maintained at >100°/>1 atm. without boiling, *e.g.*, at 160°/15—20 kg. per sq. cm. Apparatus is figured. F. R. BASFORD.

Rolls for dough sheeting and like machines. Baker Perkins, Ltd. (B.P. 714,914, 20.7.50).—The roll is provided with a forced-fit tube or sleeve of a polymer of tetrafluoroethylene having a thickness of ~$\frac{1}{6}$ that of the inner core. The surface is non-adhesive to dough and the necessity of peeling it from the roll and dusting with flour is avoided. J. W. MULLIN.

Mechanical moulding of dough pieces in bread making. Allied Bakeries Ltd. (Inventor: H. G. H. Embrey) (B.P. 713,617, 1.11.52).—The device incorporates a cutter with positional rotation of the dough pieces through 180°. K. RIDGWAY.

Manufacture of wafers, waffles, and similar baked products. T. & T. Vicars Ltd., J. A. Hatton, and W. J. Crompton (B.P. 715,345, 22.12.51).—Apparatus is figured and claimed. F. R. BASFORD.

Apparatus for the continuous extraction of sugar from beet. K. Heinrich (Fr.P. 1,072,607, 3.1.53. Ger., 3.1.52, and addns. 5.3.52, 29.7.52, and 17.12.52).—Cossettes, together with hot juice, are passed into a short mixing chamber which has beater arms at either end and a helical screw conveyor along its length. The pulped mixture, containing about 35% of cossettes, is pumped into the base of a tower diffuser through a rotating scraper arm placed just above the bottom sieve of the tower. This arm also provides a lifting action so that the beets are continuously fed upwards. Water enters the tower at the top and on passing through the bottom grid rises through a side-arm and out through an overflow pipe at a suitable height. Cossettes are removed at the top by the operation of a rotating propeller and a continuous rake conveyor. Various ancillary details are described. SUG. IND. ABSTR. (E. M. J.).

Apparatus for extraction of vegetable materials, especially sugar beet cossettes. Oppermann & Deichmann (Inventor: H. Brunke) (Ger.P. 916,880, 20.7.51. Addn. to Ger.P. 853,880 and 857,930).—The cossettes are carried by a rake conveyor along a tube running horizontally, curved round and down, and back again. The ends of the tube have vertically rising portions in which initial washing of the cossettes and final drainage can take place. At intervals along the tube grid elements may be placed, the teeth of the rake conveyor passing through the slots, so that in their passage through the grid the cossettes are lightly compressed. The extracting water flows in countercurrent to the cossettes. SUG. IND. ABSTR. (E. M. J.).

Potato chip construction. B. Stahmer (B.P. 713,925, 25.9.52).—A potato chip of improved firmness and edibility is characterised by several alternate ridges and furrows in parallel arcuate paths on both sides. The ridges have divergingly disposed side-walls ending in a widened base and the furrows on opposite sides laterally intersect to provide the chip with spaced perforations. F. R. BASFORD.

Blancher for peas and beans. Thomas Marsden Jones (B.P. 713,210, 7.2.52). A vertical tube, perforated at the base, is placed in an outer closed chamber containing heated water. Peas are fed in over steps to remove detritus (cf. B.P. 655,066), are blanched and then ejected by a high-pressure water steam. K. RIDGWAY.

Method of clarifying malt liquors or beer. A.-B. Separator (B.P. 715,988, 23.4.52. Sw. 30.4.51).—The liquor is liberated from part of the yeast and protein substances by separating in a centrifuge at ~5°. It passes to a cooler and then to a plate-type filter press at −2°. Care should be taken to prevent any temp. rise during filtration. J. W. MULLIN.

Manufacture of beer. O. Bienz and W. E. Schultheis (B.P. 715,948, 30.3.51. Ger., 27. and 30.9., and 20.11.50).—Beer can be produced more cheaply by using ultrasonic vibrations (from a 1000-kc. per sec. generator delivering ~300 vibration w.), at various stages and at elevated temp. Hops or sediment are treated in this manner at 50—60° for 1—2 hr. (pH 5—6) in the presence of brewing

water, wort, or a mixture of the two, to obtain an extract used for bittering the main body of the wort. This reduces the loss of bittering substances due to their expulsion from the wort together with the protein pptn. The main body of wort is then treated with the extract. The quantity of hops required is reduced by 40% compared with the normal treatment. About 185—200 parts of extraction liquid to 1 part of hops is used so that only a small quantity of tannin passes over into the extract, the bulk remaining with the spent hops. The wort can also be subjected to ultrasonic vibrations during the boiling stage. When operating the conventional two-mash process, the residual mash is subjected to vibrations in the mashing vat for 1 hr. at 50—60°. The first mash is then mixed with this treated mash. Complete details and examples of this process are given. J. W. MULLIN.

Production of beer using sonic frequency vibrations. O. Raudszus Assee. of W. Kleber (B.P. 713,888, 24.4.52. Ger., 27.4.51).—Hop cones, pulverised hops, or hop extracts are subjected to mechanical vibrations of sonic frequency, prior to working up into beer, to render the hops more sol. and facilitate extraction of the bitter principle. F. R. BASFORD.

Treatment of alcoholic distillates. A. J. Menzies, N. G. C. Hendry, and John Green (B.P. 713,658, 24.7.51).—Alcoholic distillates, *e.g.*, brandy, gin, rum, and whisky, when treated with 1 g. per 100 c.c. of a synthetic polymeric cation-exchange material containing free acid groups, *e.g.*, Amberlite IR-100 or -120, Dowex-30 or -50, Liquonex-CRQ or -CRW, and Zeo-Karb-215, -225, or -315, either batchwise or by a continuous column process, undergo changes comparable to the changes occurring during maturation without the long interval previously necessary. Optimum conditions for treatment are defined. I. JONES.

Production of skim milk cheese. De Laval Separator Co. (B.P. 714,552, 11.9.52. U.S., 18.9.51).—Curds of smooth texture and low enough water content (~75%) for direction consumption (as cheese) are obtained in a continuous and rapid process by keeping a mixture of low-fat (skim) milk and starter at 70—78° F., then heating the pptd. curds to 80—100 (90)° F., and feeding (at pH ~4·5) to a centrifuge. The curd is discharged at high speed and impacted against the stationary collecting cover of the centrifuge, and may be subsequently subjected to grinding operation (*e.g.*, in a colloid mill or homogeniser) to remove graininess. Apparatus is figured. F. R. BASFORD.

Manufacture of cheese of the Cheddar type. Kraft Foods Co. (Inventors: N. Kraft, K. W. Snyder, and J. B. Stine) (B.P. 715,500, 30.1.52).—Cheddar cheese, of improved quality and controlled moisture content, is obtained by treating the drained curd in the form of discrete particles with aq. (4—15%) NaCl at 85—135° F., then separating, placing in forms, and curing. Apparatus is figured. F. R. BASFORD.

Manufacture or preservation of cheese. Nat. Research Development Corp. (Inventors: A. T. R. Mattick and A. Hirsch) (B.P. 713,251, 7.3. and 16.5.51).—In the manufacture of Gruyère, Comté, Beaufort, Emmenthal, Brie, Danish-Swiss, Swedish Manor-House cheese etc., growth of *Clostridia* is inhibited and subsequently blowing or distension of the cheese thereby minimised, by use of a starter comprising nisin or a nisin-producing bacterial culture, optionally used in conjunction with (1 pt. of) a non-antibiotic-producing culture (in a combined concn. of 0·5—2 vol.-%). F. R. BASFORD.

Insulating [cardboard] container for ice-cream. A. Vonarburg (B.P. 713,640, 1.2.51. Switz., 14.4.50).—The box is constructed so that an inner compartment is held inside an outer compartment by its upper edge only, the intervening air layer forming the insulation. K. RIDGWAY.

Manufacture of frozen confections. N. Stoddart (B.P. 714,656, 6.8.52).—A frozen (lollie) confection is obtained by pouring a lollie mixture into a mould, inserting therein a parallel line of sticks, freezing the mixture, immersing in an elongated mould containing unfrozen ice cream, freezing again, and cutting the resulting composite bar. F. R. BASFORD.

Appliance for washing eggs and other solid materials [e.g., fruit, nuts, vegetables]. A. Howie and T. Ogston (B.P. 715,248, 24.9.52). —Apparatus is figured and claimed. F. R. BASFORD.

Food and beverage blender. Winsted Hardware Mfg Co. (B.P. 714,021, 21.7.52. U.S., 4.1.52).—To ensure accurate register of the shafts of the drive and the driven blades, the shell is built in two overlapping halves with a gap for circulating air, the shell being supported on the motor, instead of *vice versa* which is more normal. K. RIDGWAY.

[Improving the binding properties of] meat sausages [and pastes etc.]. Van Hees G.m.b.H. (B.P. 714,500, 29.5.51. Ger., 5.11.48).—A small proportion (0·3—0·5% by wt.) of water-sol. alkali metal salt of pyro-, meta-, or poly-phosphoric acid or a mixture with a similar salt of orthophosphoric acid is added to the meat. A larger addition leads to over-peptisation and softening of the meat fibres. The condition of the fibres can be further improved by addition of citric, tartaric, or adipic acids. Palatability can be improved by the addition of soya-bean meal, milk powder, and the flesh of fish and crabs. J. W. MULLIN.

Treatment of food and other organic produce. M. E. Dunkley (B.P. 715,351, 6.2.52).—Spoilage of food, etc. (meat, vegetables, fruit, fruit juice, milk products, grain, eggs), by atmospheric or auto-oxidation catalysed by enzymes present, is prevented by keeping in a gaseous atm. containing CO_2 8·2—10·5 (9·2), CO 2·2—4 (3·2), acetylene 0·05—0·2 (0·1), olefines 0·01—0·2 (0·1), paraffins 0·4—1·4 (0·6), H_2 1·2—2·4 (1·6), argon 0·9—1·1 (1), N_2 83—86·5 (84·2), and O_2 ≯ 0·05 (0) vol.-%, obtained by controlled combustion of fuel gas, *e.g.*, natural gas. F. R. BASFORD.

Dietary salt substitute. E. Fougera & Co. (Inc.) (B.P. 713,803, 20.2.52. U.S., 3.4.51).—A non-irritant dietary salt substitute, stable at cooking and baking temp., comprises KCl particles 70—85% coated with a binder (starch, optionally mixed with gum) and glutamic acid (or its K or Ca salt) 0·05—2 wt.-%. Thus KCl (83·3) is sprayed (while stirring) with an aq. solution of gum arabic (2), sol. starch (14), and glutamic acid (0·08 pt.) at 70—80° until dry, and the resulting product is sieved to 30 in. mesh. F. R. BASFORD.

Sterilisation of canned foods. H. J. Heinz Co. (B.P. 713,031, 3.12.51. U.S., 19.2.51).—The cans are sterilised by passage on conveyors through a steriliser filled with a mixture of tri- and tetrachloroethylene vapours, which gives easy temp. control between the limits 189° and 250° F. and gives a high rate of heat transfer to the cans. K. RIDGWAY.

Apparatus for processing material in containers. Chain Belt Co. (B.P. 714,616, 2.1.52. U.S., 8.1.51).—An improved mechanism for handling tins of food in a sterilising or cooking oven is described. (cf. B.P. 654,468.) J. W. MULLIN.

Packing for liquid, semi-liquid, or plastic commodities. G. A. Tomik (B.P. 714,966, 20.5.52).—Waxed paper cartons without bottom discs are stacked so as to form a long tube which is filled with the material (*e.g.*, ice cream, butter, food pastes etc.). By a system of looped draw strings cutting means any no. of cartons can be detached from the pile, and bottom discs are then inserted. J. W. MULLIN.

3.—SANITATION

DDT-dehydrochlorinase, and enzyme found in DDT-resistant flies. J. Sternburg, C. W. Kearns, and H. Moorefield (*J. Agric. Food Chem.*, 1954, **2**, 1125—1130).—The enzyme, which is present only in DDT-resistant strains of houseflies and which catalyses the dehydrochlorination of DDT to a non-toxic product (DDE) [1 : 1-dichloro-2 : 2-bis-(*p*-chlorophenyl)ethylene], requires activation by glutathione, has max. activity at about pH 7·4 and is irreversibly inhibited at pH 3·5 or lower. Activity at 27° is only about 50% of that at 37°, while at slightly higher temp., *e.g.*, 43°, activity is almost negligible. The initial rate and time of continued reaction is better maintained under N_2 than under air. The enzyme is highly specific and apparently attacks only DDT and sterically similar analogues. The rate of dehydrochlorination by alkali does not correlate with rate of enzymic dehydrochlorination of DDT analogues and it is suggested that alkali dehydrochlorination of compounds similar to DDT should not be used as a basis for deciding their fate when applied to insects. S. C. JOLLY.

Allethrin. M. Elliott (*J. Sci. Food Agric.*, 1954, **5**, 505—574).—A review with 47 references, dealing with the commercial prep. of allethrin [the (±)-*cis-trans*-chrysanthemic acid ester of (±)-allethrolone], the insecticidal activities of the eight possible stereoisomeric compounds and the effect of changes in the molecule, and comparison with the active principles extracted from pyrethrum. H. S. R.

Rodent repellents. Preparation and properties of thiouronium compounds and cyclic imides. E. Bellack and J. B. DeWitt (*J. Agric. Food Chem.*, 1954, **2**, 1176—1179).—Addition of another functional group to highly effective thiouronium rodent repellents apparently reduces their efficiency. The repellent activity of a no. of cyclic imides is affected by changes in mol. wt. or spatial configuration of other portions of the molecule. (21 references.) S. C. JOLLY.

Preservation of foods. IV. Food spoilage by rats and mice. A. J. Ophof (*Conserva*, 1954, **3**, 139—144).—A review covering the nature of the damage caused, including the carrying of infection, characteristics and habits of rats and mice, and methods for their destruction. P. S. ARUP.

Fumigation of agricultural products. X. Sorption of carbon disulphide by wheat and flour. M. S. El Rafie (*J. Sci. Food Agric.*, 1954, **5**, 536—541).—The sorption of CS_2 by wheat and wheat products is critically dependent on moisture content and is a min. at ~14% of water. It is lower than that of MeBr and appears to be mainly physical in origin. Most of the sorbed fumigant is recoverable, the remainder being held chiefly in the bran and endosperm. At high moisture contents the seed coat no longer inhibits sorption, which tends to the same limit as that exhibited by wholemeal flour. S. C. JOLLY.

Control of microbial spoilage in foodstuffs with methyl bromide. S. K. Majumdar, M. Mathu, S. V. Pingale, and M. Swaminathan (*Bull. Centr. Food technol. Res. Inst., Mysore*, 1954, **3**, 269—271).—Spoilage during drying due to heavy infestation of *Aspergillus* and *Penicillium* sp. on the surface of wet tapioca chips (28 ± 3% moisture) was prevented by preliminary fumigation with MeBr (5 lb. per 1000 cu. ft. chamber space at 80 ± 3°F. and 80 ± 5% R.H. for 24—48 hr.); unfumigated chips were spoilt within three days during drying. Fumigated chips resisted reinfestation for 8—10 days after fumigation, but the amounts of residual MeBr in the wet material was within safe limits. A mixture of EtBr and ethylene dibromide (3 : 1 by vol.) was a less effective fumigant. Similar results were obtained with wheat. S. C. JOLLY.

Tastes and odours produced by chloridation of simple nitrogenous compounds. R. S. Ingols, H. W. Hodgden, and J. C. Hildebrand (*J. Agric. Food Chem.*, 1954, **2**, 1068—1070).—In an attempt to produce disagreeable tastes and odours from possible nitrogenous pollutants of biological origin in drinking water, it was found that of 25 amino-acids or related compounds, only alanine, phenylalanine, arginine, and proline produced tastes with HOCl and monochloramine, and phenylalanine and proline did so with ClO_2. The last named amino-acids have taste threshold concn. of a few parts per billion. None of these four amino-acids was detectable or produceable in water around Atlanta, Ga., U.S.A. S. C. JOLLY.

Distribution of fluorine in various states in terrestrial waters. S. Kobayashi (*Bull. chem. Soc. Japan*, 1954, **27**, 314—317).—Using a modified Sanchis (*Industr. Engng Chem., Anal. Ed.*, 1934, **6**, 134) method, F determinations have been carried out on 39 samples of Japanese terrestrial waters, showing that the statistical exploration of fluorosis cases can only be successful when it is carried out simultaneously with a differential determination of F in various states (as F′ ions, dissolved F which can be converted into silicofluoric acid, and F in the suspended matter) present in the water. G. R. WHALLEY.

Colorimetric determination of zinc in effluents. R. F. Muraca, D. G. Gardner, and E. J. Serfass (*Plating*, 1954, **41**, 155—156, 161—163).—A colorimetric procedure for determining Zn in the range of 5—50 p.p.m. is presented. The method, which gives satisfactory results in the presence of 100—5000 p.p.m. of each of 25 ions in simultaneous admixture, is a monocolour procedure employing dithizone as the colour-forming reagent. Interfering elements are eliminated by extraction with cupferron and by complex formation with CN′ and S_2O_3''. After removal of the excess dithizone, the intensity of the red Zn-dithizone is measured with a colorimeter. The procedure can be materially shortened if the concn. of each substance other than Zn is below 1 p.p.m. A table lists the changes that can be made when the amounts of materials other than Zn are known, or can be estimated. Modified procedures for the analysis of water samples, when the concn. of Zn is as low as 0·01 p.p.m., are included. METALL. ABSTR. (R. B. C.).

Sludge digestion. D. E. Bloodgood (*Wat. & Sewage Wks*, 1954, **101**, 376—378).—Sludge digestion is believed to take place in two stages, the formation of organic acids and their subsequent decomposition. Temperatures should be maintained above 80°F. When starting a new digestion tank, the amount of old sludge used should be sufficient for proper working, and the sewage flow should be brought up to full rate gradually. Fats and oils can be decomposed if the formation of mats is avoided. A. WEBSTER.

Small-scale laboratory units for continuously-fed biological treatment experiments. I. Aëration units for activated sludge. R. Hatfield and E. R. Strong (*Sewage industr. Wastes*, 1954, **26**, 1255—1258).—A small-scale laboratory unit for aëration of activated sludge is described and adequate details of such a design are given. A. WEBSTER.

Simple laboratory apparatus for continuous treatment of waste liquors with activated sludge. P. G. Fohr and E. Kagei (*Chem. Weekblad*, 1954, **50**, 726—727).—The apparatus for experimental biological purification of waste liquor consists of an aspirator bottle with a stirrer which causes the liquid to rotate, leaving a hollow cone in the centre of the surface. A sedimentation tube is attached to the tubulure and a syphon tube leads back from the bottom of this tube to the hollow centre of the liquid surface in the aspirator. There is also a constant level overflow from the side tube. This arrangement gives good aëration, while there is no danger of frothing. G. MIDDLETON.

Simplified technique for atmospheric hydrogen sulphide studies. G. Chanin, J. R. Elwood, and E. H. Chow (*Sewage industr. Wastes*, 1954, **26**, 1217—1230).—Unglazed porcelain tiles soaked in a Pb acetate solution have been used satisfactorily for determination of H_2S in amounts less than 0·1 p.p.m. in the air (*i.e.*, less than can be detected by odour). A survey of the air in an industrial locality is described. A. WEBSTER.

Apparatus for rapid determination of toxic and dangerous volatile matter [in air]. A. D. Marsico and H. P. Guglialmelli (*Industr. y Quím.*, 1954, **16**, No. 2, 85—88, 91).—A portable apparatus is described for automatic determination of small amounts of toxic and inflammable substances in air. For H_2S, the determination is based on the grey-black colour of Ag_2S developed on a strip of paper after action of the gas on AgCN, the length of the stain being measured. For inflammable vapours, an instrument based on the Wheatstone bridge principle is shown. One Pt wire is sealed into a chamber through which the sample of air is passed : this wire is heated electrically and the change in current passing through the wire when combustion occurs is a measure of the amount of inflammable matter present. This instrument is calibrated against known mixtures of air with benzene, etc., so that a direct reading of the unknown content may be made. The application of these instruments in various manufacturing and other processes is described. H. PRITCHARD.

Removal of silica from water. Permutit Co., Ltd. (Inventor : T. R. E. Kressman) (B.P. 711,188, 9.4.52).—Water at >80° is passed through a bed of mixed anion- and H-ion-exchange resins. The anion-exchange resin is a cross-linked co-polymer of a monovinyl aromatic compound (*e.g.*, styrene) which has been haloalkylated and aminated. The bed is reactivated with 5% aq. NaOH at 80°. J. W. MULLIN.

Separation [and washing] of heavy solids from sewage and other liquids. C. J. Hartley (B.P. 710,435, 19.10.51).—In rectangular settling channels, to avoid two pumping operations the solids washing apparatus is mounted on a gantry so that the solids, after raising, can be washed free of adherent organic matter and the cleaned grit delivered by gravity. K. RIDGWAY.

4.—APPARATUS AND UNCLASSIFIED

Direct determination of methyl mercuric dicyandiamide. D. Polley and V. L. Miller (*J. Agric. Food Chem.*, 1954, **2**, 1030—1031).—A colorimetric method using dithizone is described for the determination of 1—100 μg. of methyl-mercuric dicyandiamide or chloride in aq. solution with an accuracy of ±3%. Up to 1·0 mg. of common metallic ions, including Hg^{II}, does not interfere. The method depends on the extraction of the compound with $CHCl_3$ in presence of NaCl and hydroxylamine hydrochloride and HCl, and shaking the $CHCl_3$ extract with aq. NH_4 acetate and a $CHCl_3$ solution of dithizone. The colour in the $CHCl_3$ layer is measured at 620 mμ. S. C. JOLLY.

A high speed glass osmometer. J. V. Stabin and E. H. Immergut (*J. Polymer Sci.*, 1954, **14**, 209—212).—A new osmometer which has a greater effective membrane area to give more rapid osmotic pressure determinations is described with diagrams. PLASTICS ABSTR.

A convenient electric viscometer for liquids showing normal and structural viscosity. E. Helmes (*Kolloidzschr.*, 1954, **138**, 2—5).—A new electric viscometer is described. The sample is placed in a beaker inside a thermostat. The torque required to rotate a vertical cylinder mounted centrally inside the beaker, at five different constant speeds of rotation, is measured by an ammeter with variable shunt, which shows the current used. The electric circuit is shown. For investigating changes in η with time the current can be applied to a pen recorder. A. B. DENSHAM.

Viscous flow in supersaturated solutions. S. D. Jha (*Kolloidzschr.*, 1954, **137**, 162—163).—A preliminary note on the measurement of η of supersaturated aq. solutions at different rates of shear. Increase in η is related to degree of supersaturation and ionic strength. For electrolytes, but not for non-electrolytes, apparent η decreases with increased rate of shear. It is suggested that dipolar H_3O mol. take part in the formation of a structure which gradually disappears with increasing shear. Evidence in favour of the Debye and Hückel theory of strong electrolytes is provided. A. B. DENSHAM.

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