ROTHAMSTED RESEARCH

Report for 1955

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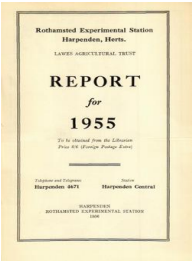

Departmental Publications / Abstracts of Papers

Rothamsted Research

Rothamsted Research (1956) *Departmental Publications / Abstracts of Papers ;* Report For 1955, pp 210 - 250 **- DOI: https://doi.org/10.23637/ERADOC-1-77**

PUBLICATIONS

Physics Department

Book

1. Penman, H. L. (1955). *Humidity*. London: The Institute of Physics.

General Papers

2. Long, I. F. (1955). Dew and guttation. *Weather*, **10**, 128.
3. Long, I. F. (1955). Frozen dew. *Weather*, **10**, 199.
4. Penman, H. L. (1955). Water control for increased crop production. *Advanc. Sci., Lond.*, **12**, 29.
5. Penman, H. L. (1956). Evaporation: an introductory survey. *Neth. J. agric. Sci.* (In the press.)

Research Papers

6. Emerson, W. W. (1955). Complex formation between montmorillonite and high polymers. *Nature, Lond.*, **176**, 461.
7. Emerson, W. W. (1956). Synthetic soil conditioners. *J. agric. Sci.*, **47**, 117.

The ability of various high polymers to stabilize soil crumbs has been investigated using the sodium saturation technique. The soil used came from two plots on the Rothamsted classical fields, Barnfield and Hoosfield, which have received no fertilizer, either organic or inorganic, for 80 years, but whereas the former contains free $CaCO_3$, the latter is acid. The polymers tested were polyvinyl alcohol, sodium alginate, a vinyl acetate–maleic acid co-polymer, polyacrylic acid and a dextran. It was necessary to add 0·2–0·5 per cent weight of the polymers in solution to the calcareous soil to produce crumbs of maximum stability, i.e., not dispersing in distilled water. The alginate, however, was effective only if the crumbs were first sodium saturated. With the acid soil, the amount of polyvinyl alcohol necessary for maximum stability was slightly reduced corresponding to the lower clay content of the soil, whereas only one-tenth the concentration of the maleic acid co-polymer was required. Sodium alginate had no effect on the acid soil.

From the swelling pattern of the Na-saturated crumbs in dilute salt solutions it was inferred that the non-ionic polymers, polyvinyl alcohol and the dextran form inter-lamellar complexes, whereas the carboxylated polymers are joined to the edge faces of the crystals. The presence of divalent cations is unnecessary for this edge linkage, as the polymers are equally effective when sodium ions only are present. It is suggested that the polymers form a series of hydrogen bonds with the exposed oxygen and hydroxyl atoms of the octahedral layer. Since these atoms have a greater tendency to co-ordinate a hydrogen ion as the pH is lowered, the carboxylated polymers would be expected to be more efficient on acid soils.

A simplification of the sodium saturation technique for the evaluation of potential soil conditioners is given.

8. Emerson, W. W. (1956). A comparison between the mode of action of organic matter and synthetic soil conditioners in stabilizing soil crumbs. *J. agric. Sci.* (In the press.)

Synthetic soil crumbs stabilized by the addition of small quantities of a polymer, and natural soil crumbs from old grassland, have been extracted with neutral sodium pyrophosphate and alkali and the strengths of the crumbs compared before and after extraction, using the sodium saturation technique. Three polymers were used: polyvinyl alcohol (a non-ionic polymer), sodium

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alginate and a vinyl acetate–maleic anhydride co-polymer (Vama), the latter both carboxylated polymers. Pyrophosphate was able to displace the carboxylated polymers from the synthetic crumbs, but not the stabilizing fraction of the organic matter from the grassland crumbs. 0·5*N*-NaOH produced a much greater reduction in the strength of the alginated treated crumbs compared with Vama crumbs, which is attributed to the weaker hydrogen bonds formed by the former. Prolonged leaching with alkali removed a considerable part of the stabilizing organic matter in the grassland crumbs. Neither method of extraction affected the stability of the polyvinyl alcohol crumbs.

It is concluded that the grassland crumbs are stabilized by the formation of inter-lamellar complexes with the clay in the crumbs, and probably that the substance forming the complexes is a polymer and contains amino-groups.

Evidence is also given that phosphate ions and the carboxylated polymers are attached in the same manner to the edges of the clay crystals.

9. Long, I. F. (1956). The direct evaluation of psychrometric data from dry- and wet-bulb recorders. *J. Sci. Inst.* **33**. (In the press.)

10. Monteith, J. L. (1956). Evaporation at night. *Neth. J. agric. Sci.* (In the press.)

Direct measurements of evaporation from a short grass surface are compared with humidity gradients in the grass. At night, when the air in the cover is unsaturated, evaporation takes place by the diffusion of water vapour from the soil surface through a thin air layer in which the transfer coefficient is seldom greater than twice the molecular value.

11. Penman, H. L. (1955). Weather and farming, 1954. *Quart. J. R. met. Soc.* **81**, 507.

1954 weather was most marked in its grievous interference with soil management and crop husbandry. Farming skill and energy succeeded in doing much to counteract this, so much so that final yields were generally above average. The weather generally retarded growth and encouraged fungus diseases, so reducing quality. Some of the effects of 1954 weather may appear in 1955 crops.

12. Penman, H. L. (1955). Evaporation from Lake Eyre. In: *Lake Eyre, South Australia. The Great Flooding of 1949–50, (Roy. Geog. Soc. Australasia, Adelaide)*, pp. 57–61.

Computed values of evaporation, based on weather data for October 1950 to December 1951 give a total of 105 inches for 14 months, ranging from 1·5 inches in June to 13 inches in January 1951. Direct measure (based on some eye observations) totals 120 inches for the same period.

13. Penman, H. L. (1956). Estimating evaporation. *Trans. Amer. geoph. Un.*, **37**, 43.

The physical basis for computing potential transpiration rate from weather data is outlined. Such computations have formed the basis of successful experiments in irrigation control, and with suitable modifications, have been applied with some success in studies of the water balance of catchment areas. Applied to two classical American watershed studies, the treatment suggests that some of the Coweeta results may need reconsideration.

14. Schofield, R. K. & Taylor, A. W. (1955). The measurement of soil pH. *Soil Sci. Soc. Amer. Proc.* **19**, 164.

A number of experimental results are presented which show the variation of the pH values of several soils when samples of each are shaken with $CaCl_2$ solutions of different concentrations.

These results are then interpreted on the basis of the ratio law—derived from the Gouy theory of the electrical double layer—and it is shown that the pH values and electrolyte concentrations show the expected relationship, provided the latter is not too large.

The importance of the connection between pH and electrolyte concentration in the routine measurement of soil pH is emphasized, and it is pointed out that such measurements must be carried out, using an electrolyte solution of known composition in order to obtain comparable results from different soils.

It has been found that 0·01*M*-$CaCl_2$ is the most satisfactory for use in normal non-saline soils where the surface density of electrical charge on the colloidal material is high and independent of the solution composition: this electrolyte concentration is such that measurements made with the usual glass electrode/saturated calomel cell give accurate and reproducible values which are largely independent of the soil/solution ratio, and are yet sufficiently dilute to allow a satisfactory calculation of the "lime potential" characteristic of the soil sample.

Chemistry Department

15. Cooke, G. W. (1954). Recent developments in the use of fertilizers. *Agric. Progr.* **29**, 110.

The changes in fertilizer consumption in the United Kingdom from 1913 to the present time are described. Fertilizer efficiency may be increased by using the results of soil analysis and by applying placement methods. Current fertilizer practice is discussed in relation to the improvements which are possible in manuring under various systems of farming.

16. Cooke, G. W., & Widdowson, F. V. (1955). Fertilizer placement for arable and herbage crops. *Herb. Abstr.* **8**, 233.

A general account of the benefits of fertilizer placement for cereals, row crops, horticultural crops and herbage crops. An account is also given of fertilizer placement research in other European countries.

17. Cooke, G. W. (1955). Field experiments on phosphate fertilizers. *N.A.A.S. quart. Rev.* **27**, 95.

A summary is given of the results of war-time and post-war field experiments, testing alternatives to superphosphate.

When used for direct application, soft North African rock phosphates and phosphate from Curacao in the West Indies behaved similarly, Florida pebble phosphate was inferior to other rock phosphates. For swedes grown on acid soils North African rock phosphates were from 60 to 90 per cent as efficient as superphosphate. For potatoes on acid soils and for establishing reseeded grassland rock phosphates were as effective as only one-third as much phosphorus supplied as superphosphate; on neutral soils they were useless for any of the crops tested.

Silicophosphate behaved like a very high-grade, high-soluble basic slag. It was roughly equal to superphosphate for swedes and potatoes grown on very acid soils. On neutral soils silicophosphate was inferior to superphosphate for all crops.

Dicalcium phosphate was equivalent to superphosphate for swedes grown on all kinds of soil; for potatoes it was slightly superior to superphosphate on very acid soils and slightly inferior on neutral soils.

Three kinds of nitrophosphate, made by treating rock phosphate with nitric acid followed by ammoniation, were compared with superphosphate. The phosphorus in all three products was equivalent to phosphorus in superphosphate for swedes. The nitrophosphates were inferior to equivalent mixtures of superphosphate plus nitrogen fertilizers for potatoes and for grass; they tended to be more effective on acid soils than on neutral soils. In the different years of the experiments the same kinds of nitrophosphates gave variable results. It appeared that the manufacturing processes needed further investigation so that stabilized products with consistent performances could be marketed.

18. Cooke, G. W. (1955). Make good what the rain washed out. *Fmr & Stk-Breed.* 15 February, p. 55.

An article for farmers. The factors which must be taken into account in planning manuring with nitrogen and potassium are discussed.

19. Cooke, G. W. (1955). Making the best use of fertilizers. *Times Agric. Rev.* Spring 1955, 20.

An account of the purposes for which fertilizers are applied in the United Kingdom. Methods of improving the efficiency of manuring are described.

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20. Cooke, G. W. (1955). Alternatives to superphosphate. *Agriculture, Lond.* **62**, 27.

Tests with various phosphates have been carried out both during and since the war in an attempt to find a substitute for superphosphate which will not make such heavy demands on sulphuric acid in its manufacture. The results of the work are described.

21. Cooke, G. W. (1955). A summary of the results of fertilizer placement research in Great Britain. *Bull. Docum. Assoc. int. Fabr. Superph.* **18**, 16.

A summary in French and English of recent work.

22. Widdowson, F. V. (1955). Precision is the aim and placement is the method. *Agric. Rev. Lond.* **1**, no. 5, 40.

The advantages and disadvantages of various methods of applying fertilizer for common farm crops are described.

Research Papers

23. Benzian, B. (1955). Nutrition problems in forest nurseries. Summary report for 1953. *Rep. For. Res. For. Comm. for 1953–54*, 38.

24. Bremner, J. M. (1955). Studies on soil humic acids. I. The chemical nature of humic nitrogen. *J. agric. Sci.* **46**, 247.

The chemical nature of the nitrogen in humic acid preparations isolated from 0·5*M*-sodium hydroxide and 0·1*M*-sodium pyrophosphate (pH 7·0) extracts of nine different soils has been studied by determining the amounts of acid-soluble-N, ammonia-N, amino-sugar-N and α-amino-N liberated by acid hydrolysis of the preparations and by paper chromatographic analysis of their acid hydrolysates. Humic acid preparations isolated from alkali and pyrophosphate extracts of the same soil differ markedly in total nitrogen content and in nitrogen distribution after acid hydrolysis. The alkali-extracted preparations have a higher nitrogen content and a higher proportion of acid-soluble-N and α-amino-N. A considerable fraction (20–60 per cent) of the nitrogen in the preparations examined was not dissolved by acid hydrolysis. The major fraction of the nitrogen dissolved was in the form of amino-acids. At least 31–48 per cent of the nitrogen in the alkali-extracted preparations and 20–35 per cent of the nitrogen in the pyrophosphate-extracted preparations was in the form of protein. From 3 to 10 per cent of the nitrogen in the preparations was in the form of amino-sugars. The results obtained by paper chromatographic analysis of acid hydrolysates of the preparations indicated that the protein materials in humic acids isolated from different soils by alkali or pyrophosphate are similar in their amino-acid composition. The following nineteen amino-acids were detected in every hydrolysate examined : phenylalanine, leucine, *iso*leucine, valine, alanine, glycine, threonine, serine, aspartic acid, glutamic acid, lysine, arginine, histidine, proline, hydroxyproline, α-amino-n-butyric acid, β-alanine, γ-aminobutyric acid and tyrosine. Two unidentified ninhydrin-reacting substances, oxidation products of cystine and methionine, and amino-sugars were also detected in every hydrolysate examined. A third unidentified ninhydrin-reacting substance and a substance provisionally identified as α, ϵ-diaminopimelic acid were found in some of the hydrolysates.

25. Bremner, J. M. (1955). Nitrogen distribution and amino-acid composition of fractions of a humic acid from a chernozem soil (Hildesheimer Schwarzerde). *Z. PflErnähr. Düng.* **71**, 63.

The nitrogen distribution and amino-acid composition of the B_a and G_a fractions obtained by fractionation of a humic acid from a chernozem soil with alkali have been investigated. The fractions were found to differ markedly in nitrogen distribution, the B_a fraction having a much higher proportion of its nitrogen in the form of acid-soluble- and α-amino-nitrogen. No marked difference in the amino-acid composition of the two fractions was revealed by paper chromatographic examination of their acid hydrolysates.

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26. BREMNER, J. M., (FLAIG, W. & KÜSTER, E.) (1955). Zur Kenntnis der Huminsäuren. IX. Mitteilung. Der Gehalt an Aminosäuren in Streptomyceten-Huminsäuren. *Z. PflErnähr. Düng.* **71**, 58.

The amino-acid composition of a humic acid-like substance produced by a streptomycete was found to differ from that of soil humic acids, particularly in tyrosine content. The amino-acid composition of streptomycete mycelium appears to be fairly constant qualitatively and little affected by the type of nitrogen supplied for growth.

27. BREMNER, J. M. & SHAW, K. (1955). Determination of ammonia and nitrate in soil. *J. agric. Sci.* **46**, 320.

Methods for the determination of ammonia and nitrate in soil are described. The ammonia and nitrate are extracted at pH 1·0–1·5 with a mixture of potassium sulphate and sulphuric acid, and the ammonia is determined by distillation with magnesium oxide at 25° C. in a modified Conway microdiffusion unit. Ammonia plus nitrate is determined on a separate sample of the same extract by reduction of the nitrate to ammonia with titanous hydroxide and subsequent distillation with magnesium oxide, both the reduction and distillation being carried out in a modified microdiffusion unit at 25° C. The methods are applicable to coloured extracts and are not affected by substances found to interfere with other methods of determining ammonia and nitrate.

28. BREMNER, J. M. & SHAW, K. (1955). Reduction of nitrate by ferrous hydroxide under various conditions of alkalinity. *Analyst*, **80**, 626.

An investigation of the reduction of nitrate to ammonia by ferrous hydroxide under various conditions of alkalinity showed that quantitative reduction of nitrate could be obtained by boiling with ferrous sulphate and magnesium oxide. The significance of this finding in relation to the determination of ammonia in soil by Olsen's method is discussed.

29. COOKE, G. W. (1955). The performances of fertilizer distributors used in field experiments. *Emp. J. exp. Agric.* **23**, 244.

The performances of two commercial fertilizer distributors in spreading powdered and granular fertilizers were compared with special reference to the use of such machines in experimental field work.

A combine-drill fitted with a star-wheel mechanism consistently delivered fertilizers more regularly than a " plate-and-flicker " mechanism fitted to a broadcast distributor. Granular fertilizers were delivered more regularly than powders. Both distributors were useless for dispensing a very fine and light powdered fertilizer (dicalcium phosphate) which did not flow by gravity. When such commercial machines are used the initial delivery should be rejected and the hopper should be refilled when three-quarters of the fertilizer has been dispensed.

The star-wheel machine delivered four granular fertilizers at rates which did not vary by more than ± 10 per cent of the average rate; the revolving-plate distributor was equally successful with three of the four granular materials. Both distributors dispensed three powdered fertilizers within these limits of variation.

Likely variations in delivery rate may be estimated by testing the performance of distributors in the field. The effect of such variations on crop yields, and therefore on the accuracy of the experiments, may be estimated by studying the responses of the crops to the fertilizers under test. By setting limits of tolerance in fertilizer delivery rates the suitability of machines for particular purposes may be estimated.

30. COOKE, G. W. & WIDDOWSON, F. V. (1956). The value of nitrophosphate for spring-sown cereals. *J. agric. Sci.* **47**, 112.

Thirteen experiments on spring cereals were carried out from 1952 to 1954 to compare broadcasting with combine-drilling for nitrophosphate and for mixtures of superphosphate plus equivalent nitrogen. Broadcast nitrophosphate was of little value, drilled dressings were much more effective. Superphosphate drilled with the seed produced consistently higher yields than broadcast superphosphate. Superphosphate plus equivalent nitrogen gave

higher average yields than nitrophosphate, both when broadcast and when drilled. When the dressings were broadcast, superphosphate was markedly superior to nitrophosphate, but when the fertilizers were drilled with the seed, average yields with superphosphate were only a little higher than with nitrophosphate.

Nitrophosphates may be substituted for mixtures containing water-soluble phosphorus for cereals, providing that they are drilled with the seed. Since nitrophosphates do not make cereals grow as rapidly as does superphosphate, even when drilled with the seed, such materials may give poor crops in conditions where the plants need a rapid start. The nitrophosphate tested contained rather more than one-quarter of its phosphorus in water-soluble form; the improved early growth observed where nitrophosphate was combine-drilled may have been largely due to this fraction of the fertilizer.

31. Cooke, G. W. (1956). The effect of some silicate slags on the utilization of soil and fertilizer phosphorus. *J. Sci. Fd Agric.* **7**, 56.

When certain silicates are applied to phosphorus-deficient soils they improve crop growth. The effects of waste slags, containing calcium silicate, from iron and steel manufacture on crop yields and on phosphorus uptakes were investigated.

In a pot experiment on barley grown on acid soil, ordinary blast-furnace slags gave smaller increases in yields than equal weights of calcium carbonate or " falling " haematite blast-furnace slags. Slags made by special steel-producing processes were more active than calcium carbonate and gave higher yields both with and without added phosphate.

In field experiments " falling " haematite blast-furnace slags behaved in the same way as ground limestone, and did not promote extra uptake of phosphorus by the crops. When no fertilizer phosphorus was applied, steel-furnace slags were more active than ground limestone, and gave higher yields of swedes containing more phosphorus. When superphosphate was applied, steel-furnace slags were still somewhat superior to limestone.

Both " falling " blast-furnace slags and the steel-furnace slags were active liming materials. Steel-furnace slags had the additional property of increasing the amounts of phosphorus taken up by the crops.

The reactions between silicates and soil phosphorus compounds require further study. Methods of characterizing products which promote the uptake of soil phosphorus by crops are needed.

32. Cooke, G. W., Jackson, M. V., Widdowson, F. V., Wilcox, J. C., & (Goodway, N. D.) (1956). Fertilizer placement for horticultural crops. *J. agric. Sci.* (In the press.)

In field experiments on vegetable crops dressings of appropriate fertilizers were placed 2 inches to the side of the seed and 2–3 inches below the soil surface and compared with the same amounts of fertilizer broadcast and worked into the surface soil. The work was carried out on ordinary arable land carrying rotations which included vegetables.

Placing fertilizer gave higher yields of cabbage, lettuce, beetroot, onions, broad beans, runner beans and maize, than broadcasting. Fertilizer, however applied, had no regular effect on the yield of french beans.

Both placed and broadcast fertilizer was tested at two rates of dressing. On average of all experiments on each crop, placing fertilizer at the low rate gave higher yields than broadcasting at the high rate. Broadcast fertilizer had little effect on yields of runner beans and broad beans, while placed dressings gave marked increases.

In two-thirds of all individual experiments placing gave higher yields than broadcasting, and in one-third of the experiments placing was significantly better than broadcasting. There were no instances of significantly higher yields from broadcasting as compared with placing.

Placing fertilizer made most of the crops grow more rapidly in the early stages than broadcasting; this improvement was often reflected in earlier maturity. For cabbage, lettuce and runner beans the relative gains from placing as compared with broadcasting fertilizer were higher at the first than at the second harvest.

By drilling fertilizer beside the seed of vegetable crops grown on ordinary soils, it is possible to economize in the dressings needed. In addition, some crops having placed fertilizers may be ready for market earlier. These

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advantages may be very profitable where high-value crops are grown, and will justify the purchase of special placement drills.

A small series of field experiments on established Brussels sprouts and autumn-planted cabbages compared mid-season top-dressings of nitrogen fertilizer broadcast by hand over the whole soil surface with dressings placed at one point beneath the surface and near to the plants. The dressings used had practically no effect on yields of Brussels sprouts. Top-dressings broadcast in spring increased yields appreciably in two experiments on cabbage, and at both centres placing gave lower yields than broadcasting.

33. Cooke, G. W. & Gasser, J. K. R. (1955). Residual effects of phosphate fertilizers on a Wealden soil. *J. Soil Sci.* **6**, 248.

A field experiment was continued for 6 years, using a 2-year rotation of beetroot or swedes followed by potatoes. Normal dressings of superphosphate and also poultry manure were applied to the first-year crops. On other plots a small dressing of superphosphate (supplying 0·2 cwt. P_2O_5/acre) was applied to each crop.

For second-year crops of potatoes a fresh dressing of superphosphate supplying 0·2 cwt. P_2O_5/acre gave yields roughly equal to those given by 1·0 cwt. P_2O_5/acre applied as superphosphate the year before.

Poultry manure used to supply phosphate had slightly greater effects on both first- and second-year crops than superphosphate supplying the same amount of P_2O_5. Higher yields from poultry manure than from superphosphate may have been due in part to extra nitrogen supplied by the poultry manure, for which no allowance was made.

Only 10 per cent of the phosphate applied had been removed by the crops grown. Soil samples from individual plots were examined when the experiment was concluded. Total soil phosphate and dilute-acid-soluble soil phosphate had not been increased by experimental dressings of phosphate fertilizer. It is suggested that much of the fertilizer phosphate applied had moved down the soil profile below the cultivated layer.

34. Heintze, S. G. (1956). The effects of various soil treatments on the occurrence of marsh spot in peas and on manganese uptake and yield of oats and timothy. *Plant & Soil*, **6**, no. 5.

Marsh spot incidences of peas were increased in some cases concomitantly with decreases in total manganese content where sodium molybdate or zinc sulphate had been added to manganese-deficient soils. The amino-acid content was higher in affected than in healthy peas. On a manganese-deficient soil, steam treatment proved superior to application of various manganese materials in increasing the yield of oat grain. Treatments increasing the manganese content of the soil induced copper deficiency in younger leaves. Timothy grown on a manganese-deficient loam failed to respond in yield to addition of various manganese higher oxides to the soil, but manganese uptake was related to reducibility as well as to ultimate particle size of the oxides.

Pedology Department

35. (Bellis, E.), Stephen, I. & Muir, A. (1956). Gilgai phenomena in tropical black clays in Kenya. *J. Soil Sci.* **7**. (In the press.)

36. Bloomfield, C. (1955). A study of podzolization. VI. The immobilization of iron and aluminium. *J. Soil Sci.* **6**, 284.

The soluble ferrous and aluminium compounds that are formed by the action of aqueous leaf extracts on ferric and aluminium oxides are sorbed to varying degrees on soil colloids. The sorption effect is particularly marked on ferric oxide, and in this case the sorbed layer has the effect of inhibiting further solution of the unreacted oxide.

Direct comparison of the extent of sorption of the reaction products of different species indicates that the extent of sorption varies inversely as the efficiency of the species as a podzol former.

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37. BLOOMFIELD, C. (1955). The experimental production of podzolization. *Chem. & Ind.* 1596.

A preliminary account of the effect of leaf extracts on columns of ferruginous sand.

38. BLOOMFIELD, C. (1955). Leaf leachates as a factor in pedogenesis. *J. Sci. Fd Agric.* **6**, 641.

A review of work on sesquioxide and clay movement delivered at a meeting of the Food and Agriculture Group of the Society of Chemical Industry.

39. BROWN, G. (1955). The effect of isomorphous substitutions on the (001) reflections of mica- and chlorite-type structures. *Miner. Mag.* **30**, 657.

The effect of isomorphous substitutions on the structure factors of the 001 reflections has been calculated for mica-type and chlorite-type structures. In the micas (including illites) variations in diffracted X-ray intensities occur due to variations in the composition of the octahedral cation sheet and the interlayer cation sheet. The calculations for dioctahedral micas deal with compositions which lie within the field whose corner members are

$$K_2(Al,Si)_8Al_4O_{20}(OH)_4$$
$$K_2(Al,Si)_8Fe_4O_{20}(OH)_4$$
$$(H_2O)_2(Al,Si)_8Al_4O_{20}(OH)_4$$
$$(H_2O)_2(Al,Si)_8Fe_4O_{20}(OH)_4$$

and similar calculations have been made for trioctahedral micas. In the chlorite structure there are two kinds of sites for octahedrally co-ordinated cations, and both the kind of octahedral cations and their distribution between the two types of site affects the 001 intensities. The structure factors for 001 reflections of chlorite-type structures with compositions between

$$(Mg,Al)_{12}(Si,Al)_8O_{20}(OH)_{16} \text{ and}$$
$$(Mg,Al)_4Fe_8(Si,Al)_8O_{20}(OH)_{16}$$

have been calculated for both symmetrical and asymmetrical distributions of the octahedrally co-ordinated cations between the two types of octahedral sites. The effect of variations in intensities due to isomorphous substitution on the standard mineral method of quantitative mineralogical analysis is pointed out and an alternative method is suggested.

40. GASSER. J. K. R. & BLOOMFIELD, C. (1955). The mobilization of phosphate in waterlogged soils. *J. Soil Sci.* **6**, 219.

Anaerobically fermenting plant material has virtually no effect on aluminium phosphate; calcium phosphates were readily attacked with consequent mobilization of both calcium and phosphate. Both phosphorus and iron were mobilized from ferric phosphates; atmospheric oxidation of the fermentation solutions caused precipitation of basic ferric phosphate together with organic matter, but significant amounts of both iron and phosphorus remained in solution after prolonged aeration. Phosphate was released from phosphated kaolinite and montmorillonite.

41. GREENE-KELLY, R. (1955). The absorption of lithium by kaolin minerals. *J. phys. Chem.* **59**, 1151.

Keenan, Mooney and Wood (1951) * have shown that kaolinites saturated with different exchange cations adsorb different amounts of water at a given relative humidity, the amount taken up generally increasing with the hydration energy of the exchange cation. The important exception was lithium kaolinite, which showed the least water adsorption of any of the samples. Keenan *et al.* suggested that the lithium ions were not in the water film, but were accommodated among the surface layer of atoms of the mineral. The work described in this paper showed that lithium ions were fixed by kaolinite after drying at 200° C. and that after fixation the mineral still managed to adsorb more cations. The occurrence of fixation was thought to indicate that the cations had migrated into the crystal rather than being located in the surface layer of atoms and the persistence of cation adsorption after lithium fixation that some structural cation exchange was also occurring.

* Keenan, A. G., Mooney, R. W. & Wood, L. A. (1951). *J. phys. Chem.* **55**, 1462.

42. GREENE-KELLY, R. (1955). An unusual montmorillonite complex. *Clay Min. Bull.* **2**, 226.

Sodium montmorillonite and pyridine form a regular complex of spacing 23·3 KX in the presence of traces of moisture. The minimum interlamellar composition necessary for the formation of the complex is approximately $NA(C_5H_5N)_4(H_2O)_2$. The intensities of the 001 reflections are considered incompatible with the complex having a five-layer structure, and an alternative arrangement is proposed.

43. MUIR, A., ANDERSON, B., & STEPHEN, I. (1956). Characteristics of some Tanganyika soils. *J. Soil Sci.* (In the press.)

44. MUIR, A. & STEPHEN, I. (1956). The superficial deposits of the lower Shire valley. *Colon. Geol. min. Res.* (In the press.)

45. SINGH, S. (1956). Formation of dark-coloured clay-organic complexes in Black Soils. *J. Soil Sci.* **7**. (In the press.)

Study of the reaction of different clays with anaerobically fermented grass extracts has shown that montmorillonoids and other high base-exchange clays favour the formation of dark clay–organic complexes. Sodium clays sorb highest amounts of organic matter and give darkest products. Acidity (pH 3–5) favours the sorption and complex formation, an observation which suggests that the formation of the black colour in black cotton soils only takes place under at least periodic anaerobic conditions, as only then can these soils with an overall pH of 8 develop slight local acidity. It is probable that certain inorganic constituents of the organic extracts also contribute to dark colour formation.

Soil Microbiology Department

46. KLECZKOWSKA, J. & KLECZKOWSKI, A. (1956). Effects of clupein and its degradation products on a Rhizobium bacteriophage, on its host bacterium and on the interaction between the two. *J. gen. Microbiol.* **14**. (In the press.)

Clupein at 0·02–0·05 per cent in the liquid nutrient medium used to cultivate nodule bacteria, rapidly killed the bacteria and slowly inactivated the bacteriophage that attacked them. When added into the bacterial culture in liquid medium before adding phage, clupein prevented phage and bacteria from combining; when added after the two have combined, clupein interrupted further stages of phage–host interaction. Clupein at 0·0016 per cent acted bacteriostatically and slowed phage multiplication but did not stop it.

Trypsin and chymotrypsin hydrolyse clupein, trypsin breaking about twice as many peptide bonds as chymotrypsin. At a concentration corresponding to 0·02–0·05 per cent clupein, the peptide produced by chymotrypsin acted bacteriostatically in the liquid nutrient medium; the peptides inactivated phage much more slowly than did intact clupein, and they inhibited phage multiplication by interfering with the combination between phage and host. When added after phage and bacteria had combined, the peptides did not interfere with further stages of phage–host interaction. The smaller peptides produced by trypsin had no effect on host bacteria, phage or phage–host interaction.

Phage preparations partially inactivated by clupein had their activity partially restored by incubation with trypsin or chymotrypsin.

Clupein, but none of its hydrolic products, made phage with much non-phage material sedimentable by slow-speed centrifugation.

47. MEIKLEJOHN, J. (1955). Soil microbiology. Some microscopical methods and results. *J. Quekett micr. Cl. ser.* 4, **4**, 171.

48. MEIKLEJOHN, J. (1955). The local wind at Milfield, Northumberland. *Quart. J. R. met. Soc.* **81**, 468.

49. MEIKLEJOHN, J. (1955). Nitrogen problems in tropical soils. *Soils & Fert.* **18**, 459.

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50. SKINNER, F. A. (1956). Inhibition of the growth of fungi by *Streptomyces* spp. in relation to nutrient conditions. *J. gen. Microbiol.* **14**. (In the press.)

Several species of soil actinomycetes arrested the growth of fungi by antibiotic secretions on agar media containing 10 g. glucose/l. On media of lower glucose concentration, the fungi continued to grow in the presence of the actinomycetes, but there was evidence that traces of antibiotic substances were still being formed by them. In sand cultures, moistened with liquid medium containing glucose, *Streptomyces albidoflavus* limited early growth of the fungus *Fusarium culmorum* by antibiotic action and also attacked preformed fungus mycelium directly. The effectiveness of these antagonistic mechanisms was lessened when the glucose concentration was decreased. The fungus and the actinomycete grew together on a variety of natural organic materials, but only when dried grass was used did the actinomycete arrest growth of the fungus at a distance.

51. SKINNER, F. A. (1956). The effect of adding clays to mixed cultures of *Streptomyces albidoflavus* and *Fusarium culmorum*. *J. gen. Microbiol.* **14**. (In the press.)

An antibiotic present in culture filtrates of *S. albidoflavus* was inactivated by clays and by suspensions and extracts of soils. When the actinomycete was grown with *F. culmorum* in a mixture of sand and bentonite moistened with a nutrient solution containing glucose, it did not antagonize the fungus by antibiotic secretions. However, some suppression of fungus growth was observed even in the presence of bentonite, particularly when the glucose concentration was high; this effect was attributed to competition between the organisms for limiting nutrients. The actinomycete also lysed the contents of fungus mycelium in sand culture but did not do so when bentonite was added. The lytic agent appeared to differ from the antibiotic. Neither antibiotic action nor direct (lytic) attack on the fungus was demonstrated in sterilized soil.

52. STEENSON, T. I. & WALKER, N. (1956). Observations on the decomposition of chlorophenoxyacetic acids by soil bacteria. *Plant & Soil*, **7**. (In the press.)

Three strains of bacteria which can decompose 2 : 4-D, MCPA or *p*-chlorophenoxyacetic acid have been isolated from soil. One, that attacks 2 : 4-D but not MCPA, is a strain of *Flavobacterium peregrinum*, Stapp and Spicher, the second is an *Achromobacter* strain, which can decompose both 2 : 4-D and MCPA, and the third is an *Achromobacter* strain that decomposes *p*-chlorophenoxyacetic acid only.

The bacterial decomposition of 2 : 4-D in soil requires aerobic conditions.

The oxidation of 2 : 4-D or MCPA by bacteria involves adaptive enzyme formation. When grown on MCPA, the *Achromobacter* strain becomes adapted to oxidize both MCPA and 2 : 4-D, but grown on 2 : 4-D it oxidizes 2 : 4-D only. If either of the 2 : 4-D decomposing organisms are grown in a medium containing *p*-chlorophenoxyacetic acid, they produce a yellow, ether-soluble acidic substance, which is colourless in acid but yellow in neutral or alkaline solution. The oxidation of MCPA or 2 : 4-D by adapted bacterial cells is incomplete, only 11–12 atoms of oxygen per molecule of herbicide being consumed. When 2 : 4-D is decomposed in pure cultures of bacteria, about 75 per cent of the chlorine in the molecule is liberated in ionic form.

There is no evidence that either 2 : 4-dichlorophenol or 6-hydroxy-2 : 4-dichlorophenoxyacetic acid are intermediates in the breakdown of 2 : 4-D.

53. STEVENSON, I. L. (1956). Antibiotic activity of actinomycetes in soil and their controlling effects on root-rot of wheat. *J. gen. Microbiol.* **14**. (In the press.)

A study has been made of conditions affecting the production of antibiotics in three soils by a number of unidentified *Streptomyces* spp. capable of inhibiting a variety of test organisms *in vitro*. In actinomycete-inoculated soils, antibiotic production was demonstrated only in sterile soils supplemented with a suitable organic source. The greatest accumulations of antibiotics were found in a neutral soil with added glucose (2·5 per cent), while under similar

conditions, no antibiotics, or only traces were recovered from acid and alkaline soils. Antibiotics, however, could be recovered from inoculated acid soil, following neutralization and the addition of glucose. Fresh grass (3 per cent), clover (3 per cent) and soy-bean meal (2 per cent) were also suitable supplements for antibiotic production by the majority of the actinomycetes, though the amounts of antibiotics were considerably less than in glucose-treated soils.

In greenhouse experiments the assessment of root-damage to wheat seedlings in sterile soil demonstrated that all the actinomycetes tested significantly reduced the degree of root-rot caused by *Helminthosporium sativum*. In the neutral and alkaline soils a relationship was evident between disease incidence and degree of antagonism exhibited by actinomycetes *in vitro*, suggesting that antibiotics were responsible. No such relationship was observed between disease control and the antibiotic-producing abilities of the actinomycetes in soil as determined by standard assay procedures.

54. TURNER, E. R. (1955). The reaction between bentonite and certain naturally-occurring compounds. *J. Soil Sci.* **6**, 319.

The reaction leading to the formation of coloured complexes between bentonite and root secretions from clover plants and also between bentonite and certain chemical compounds has been investigated. The results indicate that iron present either in the lattice or as impurity in the bentonite is an important factor in the development of the coloured complexes.

The type of crystal lattice and of the pre-treatment of the bentonite on the complex formation with the root secretions from clover plants has also been studied.

Root secretions from several species of plants have been shown to form characteristic coloured complexes with added bentonite.

Attempts have been made to elute the complexes from the bentonite.

55. WALKER, N. & WILTSHIRE, G. H. (1955). The decomposition of 1-chloro- and 1-bromo-naphthalene by soil bacteria. *J. gen. Microbiol.* **12**, 478.

Two species of naphthalene-utilizing bacteria from soil were able to metabolize 1-chloro- and 1-bromo-naphthalene. From cultures in which 1-chloro-naphthalene was the sole source of organic carbon, D-8-chloro-1 : 2-dihydro-1 : 2-dihydroxynaphthalene and 3-chlorosalicylic acid were isolated. 3-bromosalicylic acid was isolated from cultures with 1-bromonaphthalene and evidence of the formation of a " diol " compound obtained. The course of the metabolic pathways is discussed.

Botany Department

GENERAL PAPERS

56. THORNE, G. N. (1955). Nutrient uptake from leaf sprays by crops. *Field Crop Abstr.* **8**, 147.

57. THURSTON, J. M. (1955). Controlling wild oats. *Fmr & Stk-Breed.* **69**, no. 3428, p. 75.

RESEARCH PAPERS

58. HUMPHRIES, E. C. (1956). The relation between the rate of nutrient uptake by excised barley roots and their content of sucrose and reducing sugars. *Ann. Bot.* (In the press.)

A re-examination of the results of previous experiments showed that the positive regression of the rate of nutrient uptake by excised barley roots on sugar content is attributable to the reducing sugar fraction. Partial regression coefficients of the rates of uptake of potassium, nitrogen and phosphorus on reducing sugar content were all positive; those on sucrose content were either not significant or negative.

These results were confirmed for potassium by experiments in which the sugar content of the roots was varied by varying the nitrogen supply to the

plants from which the roots were taken, by shading them or by supplying sucrose to the solutions in which the excised roots were held.

59. HUMPHRIES, E. C. & KASSANIS, B. (1956). Effect of darkness on the constitution of tobacco leaves and susceptibility to virus infection. *Ann. appl. Biol.* **43**, 686.

Changes in insoluble-N, amino-N, amide-N, ammonia-N, nitrate-N, dry matter content and water content were determined in tobacco plants placed for varying periods in darkness before inoculation with tobacco aucuba mosaic virus. Nitrate-N content was highly correlated with susceptibility to infection, estimated by counts of necrotic local lesions, but the correlation was probably indirect and not causal. Changes in dry matter content, expressed either as dry matter per cent of fresh weight or separately on an absolute basis, also were correlated with susceptibility to infection.

60. OWEN, P. C. (1956). The effect of infection with tobacco mosaic virus on the respiration of tobacco leaves of varying ages in the period between inoculation and systemic infection. *Ann. appl. Biol.* **44**. (In the press.)

Leaves of tobacco plants inoculated with tobacco mosaic virus were divided into three groups: (*a*) inoculated leaves; (*b*) younger non-inoculated leaves present at the time of inoculation; (*c*) leaves formed since inoculation, and the respiration rate on a dry weight basis of each group was compared with that of similar leaves from healthy plants. The respiration rate of inoculated leaves was increased by a constant amount for three weeks after inoculation, and then it was decreased. The respiration rate of group (*b*) leaves was not affected at any time, and that of group (*c*) leaves was decreased by 10 per cent when they showed symptoms. The increased respiration of the inoculated leaves occurred too soon to be related to virus formation, and may reflect an initial change in infected cells preparatory to virus synthesis. The subsequent decrease in respiration rate may be due to accumulation of virus material which is inactive in respiration.

61. THORNE, G. N. & WATSON, D. J. (1955). The effect on yield and leaf area of wheat of applying nitrogen as a top-dressing in April or in sprays at ear emergence. *J. agric. Sci.* **46**, 449.

The yield and nitrogen content of grain of winter wheat were increased equally by 0·5 cwt. N/acre applied as an April top-dressing of " Nitro-Chalk " or by 8 sprayings of 2 per cent NH_4NO_3 solution applied to leaves or soil at the period of maximum leaf area, before and during ear emergence. April nitrogen gave a greater yield of straw than the late dressings.

The leaf area index of plots that received nitrogen in April was much larger than that of the other plots during May, but by 4 weeks after ear emergence it was less than that of plots receiving late nitrogen. Leaf area duration after ear emergence was the same for all nitrogen-treated plots, and the yield of grain divided by L.A.D. was nearly constant for all treatments.

62. THORNE, G. N. & WATSON, D. J. (1956). Field experiments on uptake of nitrogen from leaf sprays by sugar beet. *J. agric. Sci.* **47**, 12.

When the leaves of sugar beet crops were sprayed on six occasions in late September and early October with 100 gal./acre of a 3 per cent solution of ammonium nitrate or equivalent urea, in two experiments about 70 per cent of the nitrogen was recovered in the plants in mid-October, compared with 40 per cent recovered from equivalent soil applications. In a third experiment the recovery from sprays was less than 40 per cent, but very little nitrogen was absorbed from soil dressings, so that the difference between the recoveries from spray and soil applications was nearly the same as in the other experiments. More than half the nitrogen absorbed from the sprays was in the leaf laminae, and about half of this was protein.

Spraying slightly increased the dry weight of tops, but not of roots. It caused losses in yield of sugar of 0, 2 and 5 cwt./acre respectively in the three experiments.

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63. WARINGTON, K. (1955). The influence of high concentrations of ammonium and sodium molybdates on flax, soybeans and peas grown in nutrient solutions containing deficient or excess iron. *Ann. appl. Biol.* **43**, 709.

Ammonium molybdate supplying 20 or 40 p.p.m. molybdenum prevented chlorosis caused by low iron supply in young flax plants, but sodium molybdate was effective only at the higher concentration. Temporary darkening of the green colour of the shoots was also produced by 40 p.p.m. molybdenum in iron-deficient soybean and pea plants, but was soon followed by more severe chlorosis. Symptoms of molybdenum toxicity always developed when 40 p.p.m. molybdenum were given and were reduced by an increase in iron supply. In flax the higher level of iron eventually proved toxic unless it was combined with 40 p.p.m. molybdenum. High molybdenum thus counteracted both iron deficiency and excess in flax.

High iron reduced the molybdenum content (p.p.m./d.m.) of both shoot and root in soybean, peas and, provided the iron was not excessive, in flax. High molybdenum usually reduced the iron content of the shoot, but greatly increased it in the root. Molybdenum-induced chlorosis could thus be partly attributed to inhibition in iron translocation, but the beneficial effect of high molybdenum or high iron on colour was not obviously correlated with the analytical data.

Biochemistry Department

BOOKS

64. PIRIE, N. W. (1955). *The numbers of man and animals.* Edited by J. B. Cragg & N. W. Pirie. Edinburgh : Oliver & Boyd.

65. TRACEY, M. V. (1955). *Modern methods of plant analysis.* Edited by K. Paech & M. V. Tracey. Vols. 3 and 4. Berlin : Springer-Verlag.

GENERAL PAPERS

66. KENTEN, R. H. (1955). Latent polyphenol oxidase in extracts of broad bean (*Vicia faba*, L.) leaves. *3rd int. Congr. Biochem., Brussels, Resumés des Communications*, p. 102.

67. PIRIE, N. W. (1954). Fact and fancy in discussions about the origin of life. *Science & Culture, Calcutta* **20**, 261.

68. PIRIE, N. W. (1954). Leaf proteins. *Vijnan-Karmee (J. Assoc. Sci. Workers of India), New Delhi*, **6**, 14.

69. PIRIE, N. W. (1955). " Summing up " of Symposium on " The principles of microbial classification ". *J. gen. Microbiol.* **12**, 382.

70. PIRIE, N. W. (1955). New ways with trees. *Trees*, **19**, 74.

71. PIRIE, N. W. (1956). Biochemical engineering. *Jubilee Souvenir of the Soc. of Biological Chemists*, India, p. 122.

72. PIRIE, N. W. (1956). The anatomy of tobacco mosaic virus. *Advanc. Virus Res.* **4**.

73. WILTSHIRE, G. H. (1955). Changes in the organic acids of leaves associated with infection by plant viruses. *Commun. 3rd int. Congr. Biochem.* p. 102.

RESEARCH PAPERS

74. KENTEN, R. H. & MANN, P. J. G. (1955). The oxidation of manganese by illuminated chloroplasts. *Biochem. J.* **61**, 279.

Chloroplast preparations oxidized Mn^{2+} in light but not, or to a much smaller extent, in darkness. In pyrophosphate the oxidation product accumulated as a soluble manganipyrophosphate. In phosphate an insoluble

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oxidation product was formed which, like MnO_2, on treatment with pyrophosphate containing Mn^{2+} gave a soluble manganipyrophosphate. The oxidation products oxidize hydrazine and were estimated manometrically by this reaction or spectrophotometrically as manganipyrophosphate. A sensitive spectrophotometric method of estimating manganipyrophosphate has been described. The effect of variation of light intensity, period of illumination, concentration of chloroplast material and of Mn^{2+} was studied. Catalase partially inhibits the oxidation. Peroxidase increases the rate of oxidation. It is suggested that the oxidation is due, at least in part, to peroxidase systems and that a manganese oxidation–reduction cycle may play a part in the reactions of photosynthesis.

75. KENTEN, R. H. (1955). The oxidation of β-(3-indolyl) propionic acid and γ-(3-indolyl)-n-butyric acid by peroxidase and Mn^{2+}. *Biochem. J.* **61**, 353.

The oxidation of indolepropionic acid (IPA) and indolebutyric acid (IBA) by oxygen is catalysed by highly purified horseradish peroxidase preparations in the presence of Mn^{2+}. The mechanism of the reaction has not been elucidated, but the formation of hydrogen peroxide as an obligatory intermediate is suggested by the inhibiting effect of catalase. It is suggested that the previously reported oxidation of IPA and IBA by plant extracts may have been due to the presence of peroxidase and Mn^{2+} in the extracts.

76. MANN, P. J. G. & SMITHIES, W. R. (1955). Plant enzyme reactions leading to the formation of heterocyclic compounds. The formation of unsaturated pyrrolidine and piperidine compounds. *Biochem. J.* **61**, 89.

In reactions catalysed by plant amine oxidase, evidence was obtained of the formation of Δ′-pyrroline compounds from 1 : 4-diaminobutane, of 2 : 3 : 4 : 5-tetrahydropyridine compounds from 1 : 5-diaminopentane and 2 : 3 : 4 : 5-tetrahydropicolinic acid from D- and L-lysine. It is suggested that these ring compounds are formed by the spontaneous cyclization of the aldehydes or of the aldimines which are the probable products of the enzyme-catalysed reactions.

After hydrogenation of the products in presence of platinum black as catalyst, derivatives of pyrrolidine and piperidine were isolated with 1 : 4-diaminobutane and 1 : 5-diaminopentane respectively as substrates. A derivative of DL-pipecolinic acid was isolated from hydrogenated reaction mixtures with DL-lysine as substrate.

It is suggested that the amine oxidase-catalysed oxidation of 1 : 4-diaminobutane, 1 : 5-diaminopentane and L-lysine may represent the first stage in a biosynthesis of pyrrolidine and piperidine ring compounds.

77. MANN, P. J. G. & SMITHIES, W. R. (1955). Plant enzyme reactions leading to the formation of heterocyclic compounds. The formation of indole. *Biochem. J.* **61**, 107.

The oxidation of 2-(2-aminophenyl) ethylamine is catalysed by plant amine oxidase. The oxidation product accumulates in the reaction mixture as indole.

The oxidation of indole by hydrogen peroxide is catalysed by peroxidase.

78. PIERPOINT, W. S. (1956). The chromatography of leaf ribonuclease. *Biochim. biophys. Acta.*

The purification of leaf ribonuclease by cation exchange chromatography is described. The product is substantially free of other phosphatase activities, and is not inhibited by a number of anti-viral compounds and antibiotics.

79. PIERPOINT, W. S., (HUGHES, D. E., BADDILEY, J. & MATHIAS, A. P.) (1955). The effect of some pantothenate derivatives on growth and Co-enzyme A synthesis in bacteria. *Biochem. J.* **61**, 190–197.

80. PIERPOINT, W. S., (HUGHES, D. E., BADDILEY, J. & MATHIAS, A. P.) (1955). The phosphorylation of pantothenic acid by Lactobacillus arabinosus 17–5. *Biochem. J.* **61**, 368–374.

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81. PIRIE, N. W. (1956). Some components of tobacco mosaic virus preparations made in different ways. *Biochem. J.* (In the press.)

Part of the phosphorus in many TMV preparations becomes soluble in trichloroacetic acid when the preparations are incubated. There is evidence that this is caused by the fission of normal leaf nucleoprotein by ribonuclease.

Some steps in the purification remove the normal nucleoprotein, but other properties of the virus, notably its precipitability by ammonium acetate, are altered at the same time.

Ribonuclease is more difficult to remove, and it is detectable in all preparations. The smallest amount is found in those that have been ultracentrifuged from salt solutions in the presence of nucleic acid. TMV that has been denatured by TCA is a particularly sensitive system for detecting this residual nuclease.

82. PIRIE, N. W. (1956). A disintegrator for use with small quantities of fresh leaves. *J. agric. Engng Res.* **1**, 81.

A unit for pressing batches of leaves up to 50 g. in weight through a slot of adjustable width is described. By this means the leaves are ground to a controlled fineness. For work on a small scale this method of grinding is preferable to others because it is repeatable, there is no need to add any fluid to the leaves and the ground material can be recovered quantitatively.

PIRIE, N. W. & BAWDEN, F. C. (1956). Observations on the anomalous proteins occurring in extracts from plants infected with strains of tobacco mosaic virus. *J. gen. Microbiol.* **14**. (In the press.)

For summary see no. 102.

83. TRACEY, M. V. (1955). Cellulase and chitinase in soil amoebae. *Nature, Lond.* **175**, 815.

The methods used in demonstrating the production of cellulase and chitinase by three species of soil amoebae are described and an attempt is made to relate the amount formed with that found in the snail.

84. TRACEY, M. V. (1955). A rapid colorimetric distinction between glucosamine and galactosamine. *Biochim. biophys. Acta*, **17**, 159.

The differential colour depression produced by the presence of borate in the Elson & Morgan reaction is the basis of the method described.

85. TRACEY, M. V. (1955). Chitinase in some basidiomycetes. *Biochem. J.* **61**, 579.

It is shown that fungi of the *Lycoperdon* group are a useful source of active chitinase. Chitinase was found to respond to the addition of protein in a manner similar to that found by Whitaker with cellulase. Methods for the viscometric and hydrolytic assay of chitinase are described.

86. (CLARKE, P. H. &) TRACEY, M. V. (1956). The occurrence of chitinase in some bacteria. *J. gen. Microbiol.* **14**, 1.

A survey of chitinase production by representative species of the main groups of bacteria. Chitinase is produced by some but not all of the soil and water bacteria; it appears to be a constitutive enzyme in many species, and its occurrence may prove of diagnostic value.

WALKER, N. & WILTSHIRE, G. H. (1955). The decomposition of 1-chloro- and 1-bromonaphthalene by soil bacteria. *J. gen. Microbiol.* **12**, 478.

For summary see no. 55.

87. WILTSHIRE, G. H. (1956). The effect of darkening on the susceptibility of plants to infection with viruses. 1. Relation to changes in some organic acids in the French bean. *Ann. appl. Biol.* (In the press.)

The organic acid composition of extracts from leaves from plants under different environmental conditions was compared with the susceptibility of the same leaves to tobacco necrosis virus.

88. WILTSHIRE, G. H. (1956). The effect of darkening on the susceptibility of plants to infection with viruses. 2. Relation to changes in ascorbic acid content of French bean and tobacco. *Ann. appl. Biol.* (In the press.)

The susceptibility of French bean leaves to tobacco necrosis virus and of tobacco leaves to tomato aucuba mosaic virus was compared with the ascorbic acid contents of the same leaves after darkening the plant for different periods.

Plant Pathology Department

GENERAL PAPERS

89. BAWDEN, F. C. (1955). Virus diseases of plants (The Fernhurst Lecture). *J. R. Soc. Arts*, **103**, 436.

90. BAWDEN, F. C. (1955). The classification of viruses. *J. gen. Microbiol.* **12**, 362.

91. BROADBENT, L. & BURT, P. (1955). The control of potato virus diseases by insecticides. *Agric. Rev. Lond.* **1**, 60.

92. BUXTON, E. W. (1955). Fusarium Yellows of Gladioli. *Gladiolus Annual*, 1955, 27.

93. HULL, R. (1955). Mangold clamps and sugar beet growers. *Brit. Sug. Beet Rev.* **23**, 123.

94. HULL, R. (1955). Sugar Beet Yellows in Great Britain, 1954. *Plant Path.* **4**, 134.

95. HULL, R. (1955). Virus problems in sugar beet. *Proc. nat. Crop Prot. Conf.* 1955.

96. HULL, R. (1955). Sugar Beet Yellows. Ministry of Agriculture, Releases to the provincial press :

(*a*) February : The importance of clearing up infection sources in spring.
(*b*) October : Measures taken now will help to ensure a healthy crop next year.

97. HULL, R. (1955). Beet Yellows Virus. The importance of garden crops as infection sources. *J. R. hort. Soc.* **80**, 88.

98. KASSANIS, B. (1955). Carnation latent virus. *Proc. 2nd Conf. Potato Virus Dis. Lisse-Wageningen.*

99. KLECZKOWSKI, A. (1954). Intermediate stages of some viruses and enzymes in the course of their inactivation by ultraviolet radiation. *Proc. 1st Int. Photobiol. Congr.*, 59.

RESEARCH PAPERS

100. BAWDEN, F. C. & HARRISON, B. D. (1955). Studies on the multiplication of a tobacco necrosis virus in inoculated leaves of French bean plants. *J. gen. Microbiol.* **13**, 494.

By treating leaves of French bean (*Phaseolus vulgaris* L.) in various ways at intervals after they were inoculated with the Rothamsted tobacco necrosis virus, a series of events in infected cells was detected and approximately

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timed. Treating leaves with ribonuclease, or floating them in water, in the first hour after inoculation decreases the number of infections; these treatments fail to do so later, perhaps because the virus has become firmly attached to some host component, or because cells injured at inoculation have healed and no longer allow virus particles to diffuse out or ribonuclease in.

After 2 hours at 25° the virus is less readily inactivated by ultra-violet radiation than previously, suggesting that infected cells now contain more of substances that absorb radiation of 2537 Å. After 4 hours the inactivation curve with ultra-violet radiation deviates from the course of a first-order reaction, probably because some infected cells now contain more than one potentially infective particle. After 6 hours the formation of some lesions cannot be prevented by irradiation, suggesting that newly formed virus has spread from initially infected cells to deeper tissues, where it is protected from inactivation. At 16° the mean time for virus to spread from the initially infected cells is 12·5 hours, and it probably spreads from some cells by 8 hours and from most by 15 hours.

Newly formed virus is not detectable in extracts of inoculated leaves until after it has spread from the epidermis to deeper tissues. Up to 20 hours after inoculation most of the extractable virus seems to come from the epidermis, but later it comes predominantly from other tissues.

101. Bawden, F. C. & Kleczkowski, A. (1955). Studies on the ability of light to counteract the inactivating action of ultra-violet radiation on plant viruses. *J. gen. Microbiol.* **13**, 370.

Of seven plant viruses tested, all except tobacco mosaic showed the phenomenon of photo-reactivation, i.e., plants exposed to visible light after inoculation with preparations partially inactivated by ultra-violet radiation produced more local lesions than plants kept in darkness. Five strains of tobacco mosaic virus, which differed widely in their pathogenicity and other properties, were tested, but none showed the phenomenon. Of the six viruses that did, potato X showed it much the most strongly, tomato bushy stunt and a tobacco necrosis virus the least; cabbage black ringspot, cucumber mosaic and tobacco ringspot were intermediate.

Photo-reactivation does not occur immediately after plants are inoculated. With irradiated preparations of potato virus X, most particles need about 30 minutes to reach the state in which their ability to infect is affected by light; once in this state, exposure to daylight for 15 minutes gives almost complete photo-reactivation. Some irradiated particles respond to light of 80 f.c., but others need brighter light; no additional response occurs when light intensity is increased above 600 f.c. The sensitive state of potato virus X persists for about 1 hour in plants kept in darkness, after which the particles seem to be permanently inactivated.

With antibodies and enzymes, a constant amount of absorbed energy decreases the activity of a unit weight by a given fraction. This rule does not apply to plant viruses, which lose infectivity with less absorbed energy than the rule predicts. If viruses are more sensitive because they contain nucleic acid, their sensitivity is not a direct function of their content of nucleic acid. Potato virus X has the same nucleic acid content as strains of tobacco mosaic virus, but is inactivated by less absorbed energy, and individual strains of tobacco mosaic virus also differ by factors of two in the amount of radiation needed to decrease their infectivity by a given fraction.

102. Bawden, F. C. & Pirie, N. W. (1956). Observations on the anomalous proteins occurring in extracts from plants infected with strains of tobacco mosaic virus. *J. gen. Microbiol.* **14**. (In the press.)

When extracts from plants infected with various strains of tobacco mosaic virus were ultracentrifuged, the non-infective supernatant fluids still contained 0·5–5 per cent of the protein serologically related to the viruses. The small, mostly spherical, particles aggregated to form short rods as the antigen was progressively purified by precipitation with acid or salts. It formed long rods when heated in pH 5·5 buffer or when incubated with trypsin. As the particles increased in length, their serological behaviour in precipitation tests changed from " somatic " to " flagellar " type.

Purified preparations of the unsedimented antigen from plants infected

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with either of two virus strains contained 0·1–0·2 per cent phosphorus, seemingly in the form of a ribose nucleic acid. No evidence was obtained that the preparations were mixtures containing some particles with the 0·5 per cent phosphorus characteristic of infective virus and some particles of protein free from nucleic acid.

One virus strain produced a higher ratio than the others of unsedimented to sedimented antigen. The amount of unsedimented antigen was correlated with the total content of anomalous protein when the protein was increasing rapidly, but later it fluctuated unpredictably. No conditions were found that consistently favoured its accumulation, but when plants systemically infected with the type strain were kept at 36°, the total amount of antigen decreased, while the amount unsedimented sometimes increased.

The proportion of the total antigen now obtained as poorly infective nucleoprotein is much less than 10 years ago, when a third of it sedimented in the ultracentrifuge but failed to compact into a pellet. Now the uncompacted sediment, with all the host plants and virus strains used, contains only a trivial part of the total antigen.

The virus released into sap when leaves are minced is, weight for weight, more infective than the virus that remains in the leaf residues until it is released by fine grinding.

103. Broadbent, L. (1955). The effects of dates of planting and harvesting potato crops on virus-disease incidence and yield. *Ann. appl. Biol.* **43**, 149.

An experiment was done during 1953 to find out the effect of different planting and harvesting dates on the incidence of virus disease in the following year. The experiment will be repeated for 3 years. The results of the experiment might be expected to show if the widely held belief that early-lifted " immature " seed is superior to mature seed is (*a*) true, and (*b*) due to virus infection or physiological differences, or both.

Tubers were planted at monthly intervals from April to August. One tuber infected with leaf-roll virus was planted per plot, and the trial was near sources of leaf roll and Y viruses.

Half the plots of each planting were lifted 12 weeks after planting, the remainder after the haulm died.

The yield of tubers in 1953 varied between 9 tons/acre (May planting) and 4 (April, July and August plantings) when harvested after 12 weeks, but when left to maturity it fell from 26 tons/acre (April planting) to 4 (August planting).

During 1954 the progeny of tubers lifted after the haulm died in 1953 significantly outyielded those lifted after 12 weeks' growth (both healthy and leaf-roll virus-infected tubers). Leaf-roll virus caused a loss in yield of about 70 per cent.

The incidence of virus disease was small in the April, May and August plantings lifted after 12 weeks, and in the August planting lifted after the haulm died. The healthiest crop in 1954 was obtained from the April planting lifted after 12 weeks because aphids were few during the early months of 1953.

104. Broadbent, L. & Heathcote, G. D. (1955). Sources of overwintering *Myzus persicae* (Sulzer) in England. *Plant Path.* **4**, 135.

Winged *Myzus persicae* (Sulzer) that develop on *Prunus* spp. from colonies developing from eggs can be distinguished morphologically from those that develop on herbaceous hosts from colonies that overwintered viviparously. Of 238 *M. persicae* trapped during recent springs in potato, brassica and narcissus crops in different parts of England, two only had come from *Prunus* spp. Most *M. persicae* overwinter as eggs on the Continent of Europe, but in England most overwinter as living aphids.

105. Buxton, E. W. (1955). Fusarium diseases of peas. *Trans. Brit. mycol. Soc.* **38**. (In the press.)

Cultures of *Fusarium oxysporum* and *F. oxysporum* var. *redolens*, isolated from diseased pea plants growing in East England, differed in their pathogenicity. Most cultures of *F. oxysporum* behaved like the American physiologic race 1 of *F. oxysporum* f. *pisi*, but some were only weak pathogens, and one infected pea varieties resistant to races 1 and 2. This is provisionally

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named race 3A. A culture of *F. oxysporum* var. *redolens* caused a wilt indistinguishable from that caused by race 1 of *F. oxysporum* f. *pisi*. Pea wilt was the main cause of crop failures due to Fusaria up to mid-June.

Pathogenic and non-pathogenic forms of *F. solani* were also isolated from diseased peas, but usually only after mid-June. From plants showing characteristic footrot, only *F. solani* was isolated, but towards the end of June many diseased plants had symptoms characteristic of both wilt and footrot. These symptoms are thought to resemble those previously called " St. John's Disease ", and from such plants both *F. oxysporum* and *F. solani* were always isolated.

When *F. oxysporum* f. *pisi* race 1 was inoculated to peas together with either pathogenic or non-pathogenic cultures of *F. solani*, the pea plants were less severely affected than when inoculated with race 1 alone.

106. Buxton, E. W. & Richards, Marilyn G. (1955). Pathogenic strains of *Fusarium oxysporum* Fr. distinguished by their differential tolerance to inhibition by various actinomycetes. *J. gen. Microbiol.* **13**, 99.

Cultures of sixteen different soil actinomycetes were tested for their ability to inhibit the growth of eight pathogenic strains of *Fusarium oxysporum* Fr. on agar media. Three of the actinomycetes did not inhibit growth, and nine inhibited growth of all strains equally, but the other four actinomycetes consistently inhibited the growth of individual strains to different extents. The differences provide an *in vitro* test which distinguishes between certain pathogenic strains of *Fusarium* that are otherwise indistinguishable in culture.

107. Cornford, C. E. (1955). Maleic hydrazide as a shoot depressant for clamped mangolds and fodder beets. *Plant Path.* **4**, 89.

A solution of 0·25 per cent of maleic hydrazide sprayed on growing mangold plants in mid-October, and on fodder beet in early November, strongly inhibited the growth of sprouts on the roots stored in clamps or in a warm cellar, and probably reduced sprouting to well below the amount necessary to support an aphid population over the winter. The time of spraying had an important effect on the extent to which sprouting was suppressed.

108. Harrison, B. D. (1955). Studies on the effect of temperature on virus multiplication in inoculated leaves. *Ann. appl. Biol.* **44**. (In the press.)

The rate at which the Rothamsted tobacco necrosis virus accumulates in inoculated French bean leaves increases with rising temperature to 22° C. and then decreases. Three days after inoculation, leaves at 22° C. contain 4,000 times as much virus as at 10° C. and 1,000 times as much as at 30° C. At all temperatures the rate of accumulation may depend on the balance between synthesis and inactivation, but inactivation becomes increasingly important with rise of temperature above 22° C., and as the virus content of the leaves increases. Above 22° C., the rate of multiplication may increase but less rapidly than the rate of inactivation, and exposing inoculated leaves to ultra-violet radiation at various intervals after inoculation suggests that at 30° C. RTNV multiplies in and moves from the initially infected epidermal cells in slightly less than the 6 hours needed at 22° C. Thirty hours are needed at 10° C. Newly-formed virus is rapidly inactivated at 30° C. Raising the ambient temperature also decreases the numbers of local lesions, possibly by increasing the chances that the introduced virus particles will become inactivated. Increasing the virus content of the inoculum above the level giving one lesion per sq. cm. does not increase the subsequent virus content of inoculated leaves.

At temperatures of 30° C. and below, tomato aucuba mosaic virus produces necrotic lesions in leaves of tobacco and *Nicotiana glutinosa*, whereas above 30° C. the lesions are chlorotic. In both hosts this virus multiplies more rapidly when the infected cells are killed.

109. Hirst, J. M., Storey, I. F., Ward, W. C. & Wilcox, H. J. (1955). The origin of apple scab epidemics in the Wisbech area in 1953 and 1954. *Plant Path.* **4**, 91.

In England three causes of early spring infections of apple scab (*Venturia inaequalis* (Cooke) Wint.) have been proposed; conidia from infected twigs or

infected bud scales, or ascospores from fallen leaves. Power-operated suction spore traps allowed the frequency of both types of spore in orchard air to be estimated more accurately than did the types of spore trap previously used in England. In a Bramley's Seedling orchard at Wisbech, in both 1953 and 1954, conidia were rare but ascospores very common, reaching over 2,000 per cu. m. of air during a 2-hour period on 1 May 1954 soon after the end of a dry spell. Rain regularly caused ascospore liberation, from before bud-burst at the end of March until petal-fall in late May. All the evidence suggests that ascospores caused the early infections; these first occurred in 1953 at bud-burst, but in 1954 not until green-cluster.

110. HUMPHRIES, E. C. & KASSANIS, B. (1955). Effects of darkness on the constitution of tobacco leaves and susceptibility to virus infection. *Ann. appl. Biol.* **43**, 686.

For summary see no. 59.

111. KLECZKOWSKI, A. (1955). The statistical analysis of plant virus assays: a transformation to include lesion numbers with small means. *J. gen. Microbiol.* **13**, 91.

The numbers of local lesions (x) produced by different leaves when inoculated with the same virus preparation deviate greatly from a normal distribution, and the standard errors of x's depend on their magnitude. Before customary statistical analyses are applicable to results of infectivity assays, x's must be suitably transformed. When mean values of x are greater than about 10, the transformation $z = \log_{10}(x + c)$ (where c is a constant) is satisfactory, but inapplicable with smaller numbers. In some work the use of poorly infective inocula is unavoidable, and to allow statistical analysis of results in such work a new transformation $z = \log_{10}\frac{1}{2}[x + c + \sqrt{(x^2 + 2cx)}]$ is derived. This operates satisfactorily when mean numbers of x are greater than about 1·5. The results of the two transformations converge as x increases. Values of z are tabulated to make the use of the new transformations as quick as that of the other transformation.

KLECZKOWSKA, J. & KLECZKOWSKI, A. (1955). Effects of clupein and of its degradation products on a *Rhizobium* bacteriophage, on its host bacterium and on the interaction between the two. *J. gen. Microbiol.* **14**. (In the press.)

For summary see no. 46.

112. LAST, F. T. (1955). The spore content of air within and above mildew-infected cereal crops. *Trans. Brit. mycol. Soc.* **38**, 453.

In addition to *Erysiphe*, the most abundant spores in the air in mildew-infected cereal crops were *Cladosporium*, *Alternaria*, *Sporobolomyces* and *Tilletiopsis*. On dry days *Sporobolomyces* and *Tilletiopsis* were most numerous at 04·00 G.M.T. and *Erysiphe*, *Cladosporium* and *Alternaria* at 16.00 G.M.T. *Sporobolomyces* predominated throughout wet days when *Alternaria* did not occur.

Between 12.00 and 16.00 G.M.T. on dry days, *Cladosporium* spores were the most abundant; their concentration increased progressively from April to July. *Erysiphe* conidia were few during April and May, and increased rapidly to a maximum in June; *Alternaria* was very rare until July. In smutted crops, *Ustilago* spores were also very rare in April and May but equally plentiful in June and July.

The spore concentration was always greater within than above the crop, when the spores were formed on the crop. More *Erysiphe* and *Cladosporium* spores occurred near the ground than at the top of the crop; there was little difference between the concentrations of *Ustilago*.

The date of sowing affected the spore concentrations; *Cladosporium* and *Sporobolomyces* were more numerous in an early- than in a late-sown wheat crop; the differences were least near harvest. *Erysiphe* conidia were more numerous in the late-sown crop.

Higher concentrations of *Cladosporium*, *Alternaria*, *Erysiphe*, *Sporobolomyces* and *Tilletiopsis* were found in a wheat crop given fertilizer (N, P and K) than in a crop given no fertilizer.

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113. LAST, F. T. & BUXTON, E. W. (1955). Photo-reactivation of *Botrytis fabae* Sardiña measured by a local-lesion technique. *Nature, Lond.* **176**, 655.

Irradiating conidia of *Botrytis fabae* Sardiña and of *Uromyces fabae* (Pers.) de Bary with ultra-violet light reduced their infectivity, as measured by the numbers of lesions produced on half-leaflets of broad bean plants (*Vicia faba* L.). A satisfactory method of inoculation for local lesions was to rub the leaves with spore suspensions on the fore-finger. The damage to spores by the radiation was counteracted by exposing them to daylight immediately after the irradiation. The proportion of irradiated spores that infected was increased by extending the time the spores were exposed to daylight before inoculation to leaves or by exposing leaves to daylight after they were inoculated.

114. MACFARLANE, I. (1955). Variation in *Plasmodiophora brassicae* Woron. *Ann. appl. Biol.* **43**, 297.

Three races of *Plasmodiophora brassicae* were distinguished by their different capacities to form clubs on different hosts; one failed to club turnip and swede, and the others were identified by their effects on different turnip and swede varieties.

In contrast to their effects on clubbing, these races caused equal numbers of root-hair infections with zoosporangia, on all crucifers tested. It is evidently the later stages in the life cycle of the pathogen that cannot develop in club-root-resistant hosts.

Some partially resistant varieties became clubbed when spore concentrations were increased above the level necessary to cause complete infection of susceptible varieties.

Varieties susceptible to a particular race of *P. brassicae* do not seem to fall into any taxonomic group within the Cruciferae. Susceptible and resistant varieties may belong to the same species or may occur throughout a number of species and genera.

115. SALT, G. A. (1955). Effects of nitrogen applied at different dates, and of other cultural treatments on eyespot, lodging and yield of winter wheat. Field experiment 1952. *J. agric. Sci.* **46**, 407.

Lodging and yield of winter wheat were studied in a factorial experiment on land infested with the fungus *Cercosporella herpotrichoides* Fron. causing eyespot. Two varieties, Squareheads Master 13/4 with long, and Bersée with short straw, were compared at two seed rates; sulphate of ammonia was applied at 0, 2 and 4 cwt./acre at four different dates; four of the eight blocks of ten plots were sprayed in March with sulphuric acid to control eyespot.

Lowering the seed rate from 3 to 1½ bushels/acre decreased eyespot and the area lodged, and increased the mean yield of the two varieties by 4·9 cwt./acre in unsprayed and 2·1 cwt./acre in sprayed plots. Spraying the variety Squareheads Master decreased the straws with severe lesions from 66 to 17 per cent, the area lodged from 95 to 36 per cent, and increased grain from 22·4 to 32·4 cwt./acre; spraying Bersée decreased severe lesions from 56 to 15 per cent, lodging from 54 to 1 per cent and increased yield from 32·6 to 43·5 cwt./acre.

The mean percentage infection at harvest was little affected by nitrogen applied in March, April or May, but was decreased by nitrogen applied in October. In contrast, the time of applying nitrogen greatly affected the weight of straw and the extent of lodging, both of which were increased more by top dressings in March and April than by those in May. Plots that received nitrogen in March and October had similar weights of straw, but the latter, with less eyespot, lodged less. Where lodging was slight, grain yields were increased equally by nitrogen applied at each date; where lodging was extensive, yields were depressed by dressings in March and April, and increased by those in October and May. Sulphate of ammonia applied at 0, 2 and 4 cwt./acre to sprayed (upright) plots of Bersée yielded respectively 36·8, 42·9 and 47·3 cwt. of grain, whereas applied to unsprayed (completely lodged) plots of Squareheads Master yielded only 22·4, 22·0 and 22·9 cwt./acre respectively.

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116. WATSON, M. A. (1955). The effect of sucrose spraying on symptoms caused by beet yellows virus in sugar beet. *Ann. appl. Biol.* **43**, 686.

When leaves of sugar-beet plants infected with beet yellows virus were sprayed daily with 10 per cent sucrose solution, yellowing symptoms were intensified. When the light intensity was reduced to less than half of full daylight, yellowing symptoms were suppressed more completely on unsprayed than on sprayed plants.

Spraying with 2·5 per cent sucrose solution increased the carbohydrate content of the leaves, and the effect on symptom intensity and carbohydrate content were closely correlated in both shaded and unshaded plants. As the severity of symptoms was increased by supplying carbohydrate without change in the light conditions, it is concluded that light intensity affects symptom expression by varying the carbohydrate content of the leaves through its influence on photosynthesis.

Sucrose spraying increased the yield of roots of healthy and infected plants by about the same amount. Most of the increase was sucrose, showing that sprayed sucrose was translocated to the roots from the leaves of both healthy and infected plants.

Measurements of diurnal changes in carbohydrate concentration support the view that movement of carbohydrate out of infected leaves is not stopped by infection.

Nematology Department

GENERAL PAPERS

117. (BASDEN, E. B.) & GOODEY, J. B. (1955). A nematode parasite of *Drosophila*. *Nature, Lond.* **175**, 431.

118. (MORETON, D. B., JOHN, M. E.) & GOODEY, J. B. *Aphelenchoides* sp. destroying mushroom mycelium. *Nature, Lond.* (In the press.)

119. PETERS, B. G. (1955). Control of plant nematodes. *Rep. Progr. appl. Chem.* **39** (1954), 721.

120. PETERS, B. G. (1955). Soil-inhabiting nematodes (p. 44); A note on simple methods of recovering nematodes from soil (p. 373); A note on handling and processing nematodes (p. 417); in: *Soil Zoology*. Edited by D. K. McE. Kevan. London: Butterworth.

RESEARCH PAPERS

121. DONCASTER, C. C. (1956). Electronic flash in photomicrography. *Nematologica*, **1**, 51.

An apparatus for taking photomicrographs of living nematodes and other microscopic organisms by means of high-speed flash is described in detail. Photographs taken with this equipment are used for comparison with " dead " mounts, and accurate measurements of whole or parts of living microscopic organisms can be obtained.

122. FRANKLIN, M. T. (1955). A redescription of *Aphelenchoides parietinus* (Bastian, 1865) Steiner, 1932. *J. Helminth.* **29** (1/2), 65.

After pointing out that *Aphelenchoides parietinus* as now known is probably an aggregate of several species, the author gives a detailed description of the females of a population collected from the same locality and habitat as that from which Bastian made the collection on which he based his description. The population contained no males.

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123. (Brown, E. B.) & Goodey, J. B. (1956). Observations on a race of stem eelworm attacking lucerne. *Plant Path.* **5**, 28.

A field trial showed that the lucerne race of the stem eelworm attacked lucerne var. " Grimm " and alsike clover. " Du Puits " was slightly attacked though little damaged. Oats, other legumes and the American varieties of lucerne, " Synthetic A " and " Nemastan " were resistant. The American varieties are not suitable for British conditions.

124. Goodey, J. B. & (Brown, E. B.) (1956). Stem eelworm attacking carrots. *J. Helminth.* **29**, 187.

The host range of a population of stem eelworm, found attacking carrots near Chatteris, was investigated, in the field and in pots. *Vicia faba*, oats and celery were attacked in the field, the same plants, garden peas and potatoes in pots. The population was not one of the typical oat race.

125. Goodey, J. B. & Franklin, M. T. (1956). The nematode parasites of plants catalogued under their hosts. [2nd edition of T. Goodey, 1940.] Farnham Royal: Commonwealth Agricultural Bureau. (In the press.)

In this second edition the contents have been completely revised, rearranged and brought up to date. Names of nematodes now follow the latest and generally accepted systematics. New records have been added so that the catalogue is complete, as far as possible, up to the end of 1954. There are about 6,000 entries and a bibliography with nearly 800 references.

126. Hesling, J. J. (1956). Some observations on *Heterodera major*. *Nematologica*, **1**, 56.

The hatching of cysts of *Heterodera major* is impaired by drying; dried cysts immersed in water do not appear to recover hatchability. The recovery of *H. major* cysts for population estimation purposes may present difficulty because new and full cysts may not float. A technique for the recovery of viable cysts of *H. major* is described. Cysts obtained by this method should be stored moist at about 2° C. to prevent hatching, which appears to be stimulated by increase in temperature.

127. (Lownsbery, B. F.) & Peters, B. G. (1955). The relation of the tobacco cyst nematode to tobacco growth. *Phytopathology*, **45**, 163.

An outdoor pot experiment showed that height and final weight of tobacco plants were inversely proportional to the logarithm of the initial density of viable encysted larvae of *Heterodera tabaccum* in the soil. This was true over the range 50–3,200 larvae/g. of soil. A tenfold increase in density led to a loss in plant weight of 139 g. for normal fertilized plants and 25 g. for smaller unfertilized plants. The highest density which maintained itself was 1,000 larvae/g. soil, resulting in a reduction of 25 per cent in weight of normally fertilized plants. It is not yet known whether field populations follow these pot fluctuations; the 1953 field increase was of the same order as the increase in the pot experiment.

In the field, tobacco plants grown in dichloropropene–dichloropropane-treated soil were 15–22 per cent taller than plants grown in untreated soil, but nematode reduction was confounded with other fumigant effects.

128. Peters, B. G. (1955). The combined use of nematicidal soil fumigants and solubilized chemicals. *J. Helminth.* **29**, 81.

Fumigation with " DD mixture " results in a considerable loss of vapour from the surface layer of the soil, and this loss is only moderately reduced by using a water seal or non-gas-tight seal of foil. A residue of potato-root eelworm survivors are left in this top 2 inches of soil. These can be dealt with by treating the soil surface with a similar solution of *p*–*m*-cresol solubilized by the method of Staniland and Stone. The two treatments act independently at all levels. The practical implications may be of importance in treating glasshouse soils.

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129. Reid, E. (1955). A rolling method for opening cysts of potato-root eelworm. *Plant Pathology*, **4**, 28.

Soaked cysts are placed along a channel in a metal slide and opened by rolling a glass rod over them. The clearance prevents any loss of eggs or larvae. The opened cysts are then agitated with an electric mixer to free the contents. Aliquot samples are then taken for counting.

Insecticides Department

General

Broadbent, L. & Burt, P. (1955). The control of potato virus diseases by insecticides. *Agric. Rev.* **1**, 60.

130. Potter, C. Work in England on the effect of insecticides and other chemicals used in plant protection on beneficial insects and insect populations. *Int. Union for the Prot. of Nature.*

131. Way, M. J. (1955). Beans and Blackfly. *Agric. Rev. Lond.* **1**, 1.

Research Papers

132. Burt, P. E. & Ward, J. (1955). The persistence and fate of DDT on foliage. I. The influence of plant wax on the toxicity and persistence of deposits of DDT crystals. *Bull. ent. Res.* **46**, 39.

The persistence and toxicity of DDT crystals on thin layers of plant wax were studied. Deposits of crystalline DDT at rates of 2–8 μg./sq. cm. were applied to glass plates, plain or coated with a 0·5-μ layer of wax obtained from leaves of sisal or cabbage. The plates were stored for various periods at 18° and 43° C. (representing temperate and tropical leaf-temperatures). DDT remaining after storage was estimated biologically by means of its contact action on adult *Tribolium castaneum* (Hbst.), and chemically by a modification of the Schechter–Haller method. At 18° C. there was no significant change in any of the deposits when estimated chemically. But biological estimation showed that, although the toxicity of the deposits on waxed plates was unchanged, that on glass plates was doubled after storage for 8 days. The reason for this change was not discovered. At 43° C. the amount of DDT, estimated both chemically and biologically, diminished rapidly and was negligible after 26 days. The loss of toxicity at 43° C. was shown to be accompanied by loss of weight of the deposits. Loss at 43° C. from plain glass plates could be much reduced by storing them in an atmosphere saturated with DDT vapour. It appeared, therefore, that loss of toxicity at the higher temperature was due to volatilization of DDT and not to decomposition.

Plates coated with cabbage wax, stored at 43° C. in an atmosphere saturated with DDT vapour, absorbed the vapour rapidly up to a maximum of 1·7 per cent of the weight of the wax. The plates were then toxic to *T. castaneum* crawling on them. DDT dissolved in the wax layer was found to be about as toxic as the same weight of DDT per sq. cm. in crystalline form on a glass surface. DDT dissolved in wax was found to be decomposed by short-wave ultra-violet radiation more rapidly than were DDT crystals. By irradiating deposits and then analysing them, it was shown that DDT crystals on wax surfaces, when stored for up to 14 days at 43° or 18° C., do not become dissolved in the wax to an appreciable extent, provided that the plates are stored in a ventilated container.

It is concluded that, although DDT can be taken up by a typical plant wax, this effect is unlikely to influence the toxicity of the deposit unless the DDT is able to penetrate farther than the wax layer.

133. (Thomas, W. D. E. &) Glynne Jones, G. D. (1955). The systemic properties of diethyl-S-2-(ethylthioethyl) phosphorothiolate (Demeton-S) with reference to the contamination of nectar. *Ann. appl. Biol.* **43**, 182.

The fate of diethyl S-2-(ethylthioethyl) phosphorothiolate (demeton-S) in white mustard (*Brassica alba*), borage (*Borago officinalis*) and field beans (*Vicia faba*) has been followed over several weeks using the radioactive tracer technique. Radio-assay of nectar samples from flowers which opened a few days

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after spraying showed that no unchanged demeton-S, but small amounts of degradation products, were present. The highest value for total radioactivity found in the nectar corresponded to 2·7 p.p.m. expressed as demeton-S.

Radioassay of treated leaves and new growth after spraying confirmed that demeton-S is rapidly converted in the plant into two primary degradation products extractable by chloroform. Further breakdown is more rapid in new growth, and appreciable quantities of the two primary products believed to be biologically active are retained by the treated leaves.

134. KENTEN, J. (1955). The effect of photoperiod and temperature on reproduction in *Acyrthosiphon pisum* (Harris) and on the forms produced. *Bull. ent. Res.* **46**, 599.

The effect of photoperiod and temperature on the production of the various forms of *Acyrthosiphon pisum* (Harris) has been studied. In this study apterous virginoparous females were exposed throughout their lifetime to two photoperiods (8 hours/24 hours and 16 hours/24 hours) and six different temperatures. At each of the temperatures the apterae (parent aphids) received one of four treatments of photoperiod, i.e. (1) 8-hour/24-hour photoperiod throughout their whole life; (2) 8-hour/24-hour photoperiod during the period from birth until the last (imaginal) moult (nymphal period), followed by a 16-hour/24-hour photoperiod from the last (imaginal) moult until death (the adult period); (3) 16 hours/24 hours throughout life; (4) 16 hours/24 hours during the nymphal period followed by 8 hours/24 hours during the adult period. The offspring produced by the various parents were collected at successive intervals, and their form determined.

Four main forms of offspring were produced : apterous and alate virginoparae, males and oviparae. In addition, a subsidiary form of the apterous virginoparae was obtained, which had sensoria on the hind tibiae.

Sexual forms were produced at all the temperatures below 20° C., but only by those parents which received a photoperiod of 8 hours/24 hours during their nymphal period.

Parent apterae kept at temperatures of 25–26° C. and 29–30° C. that received a photoperiod of 16 hours/24 hours during their nymphal period produced no sexual forms.

The photoperiod received by parent Aphids during their adult period had no effect on the proportion of sexual offspring they produced.

Males were only produced at 19–20° C. and at 11–13° C.; the largest proportion was produced at 19–20° C., where between 20 and 30 per cent of the total offspring were males.

Females were produced at all of the temperatures below 20° C. The highest proportion were produced at 11–13° C., where between 56 and 80 per cent of the total were oviparae.

Alatae were rarely produced in large numbers. The largest proportions were produced at the lower temperatures by those parents which received a photoperiod of 16 hours/24 hours throughout their nymphal and adult periods.

Apterous virginoparae bearing sensoria on the hind tibiae were produced at all temperatures, the largest proportion being produced by parents which received a photoperiod of 8 hours/24 hours during their adult period.

Maximum reproduction occurred at 19–20° C., decreasing at higher and lower temperatures.

At high temperatures (29–30° C.) few offspring were produced. They frequently took an abnormally long time to develop, and when mature were small in size.

Length of life of the parents increased with a decrease in temperature.

LAST, F. T. & BUXTON, E. W. (1955). Photo-reactivation of *Botrytis fabae* Sardiña measured by a local-lesion technique. *Nature, Lond.* **176**, 655.

For summary see no. 113.

135. LORD, K. A. (1955). Esterase inhibition by organo-phosphorus residues, with some observations on possible effects on plant metabolism. *Ann. appl. Biol.* **43**, 192.

Organo-phosphorus residues in tissues of sprayed plants were detected by estimating the esterase-inhibiting activity of their leaf and root extracts. This method was used to examine the anti-esterase effects of mangold plants

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that had been sprayed with " Systox ", parathion and " Hanane ". Extracts of leaves of these treated plants were shown to inhibit added choline esterase for some weeks after treatment. The enzymic hydrolysis of phenyl acetate by extracts of leaves and roots of mangold plants treated with these insecticides was reduced for varying periods of up to 8 weeks.

Assays of parts of bean plants that had been sprayed with demeton-S showed that anti-esterase activity was limited to those parts that had been sprayed : tissues developed subsequent to spraying showed no such effects. Leaves sprayed about 2 months previously inhibited added choline esterase and showed reduced activity in hydrolysing phenyl acetate. There is some evidence that substances, possible substrates in the plant enzyme systems affected, accumulate in treated leaves.

136. McIntosh, A. H. (1955). Particle size of insecticidal suspensions and their contact toxicity. V. Effect of physical properties on toxicity of compounds in the DDT group. *Ann. appl. Biol.* **43**, 161.

With each of nine DDT analogues, two types of simple aqueous suspension were made, one containing crystals of uniform size and the other containing colloidal particles. The toxicities of each pair of suspensions were compared by a dipping method on adult *Oryzaephilus surinamensis* L., kept at 11° C. for 24 hours after treatment. The colloid was always as toxic as the crystals, or more toxic. This difference in toxicity varied from one analogue to another. It was related to the physical properties of the analogue in the following way.

Dipping applies poison to the insects; the amounts retained could usually be found by extraction and micro-analysis. Retention of poison from colloidal suspension was about the same for each analogue; but crystals were retained either more or less efficiently than colloid, depending on their size and shape. Poorest retention was found with plate-like crystals of about 25 μ.

The true ratio of toxicities for each analogue (colloid : crystals) was found by correcting the observed ratio for differences in retention; but even then there were still big differences amongst the ratios given by the different analogues.

The true ratio was taken as a measure of the difference in speed of action between the two forms of poison. If the compound could kill *O. surinamensis* by fumigant action alone, the true ratio was very small. Otherwise, it seemed to depend on two physical properties related to the process of solution of poison in the wax of the insect cuticle. They were both measured in *in vitro* tests. The film made by evaporating a drop of colloidal suspension on glass is at first globular, but it may sooner or later crystallize. The film made by evaporating a drop of a suspension of crystals can be dissolved in olive oil. If the film of crystals brought about saturation of olive oil slowly and if, in addition, the deposit from colloid crystallized slowly, the true ratio was large. Unless the analogue had both of these properties the true ratio was small. If the analogue had one or other of the properties the true ratio could be increased either by increasing the crystal size or by decreasing the rate of crystallization.

Physical properties of this sort may often affect the results of tests of insecticides, and should be taken into account when the toxicities of different compounds are compared.

There seems to be no relation between lipoid-solubility and toxicity of compounds in the DDT group. Rate of solution is probably more important.

137. Potter, C., Healy, M. J. R. & Raw, F. (1956). Studies on the chemical control of wireworms (*Agriotes* spp.). I. The direct and residual effects of BHC, DDT, D-D and ethylene dibromide. *Bull. ent. Res.* **46**, 913.

Following crop failures due to wireworm (*Agriotes* spp.) attack on Little Hoos Field, Rothamsted, two experiments were made on the use of four chemicals to prevent wireworm attack on wheat. The chemicals used were BHC, technical DDT, ethylene dibromide and D-D.

Benzene hexachloride in the form of a dust containing 3·5 per cent crude BHC was broadcast at the rate of 7·9 lb./acre crude BHC ≡ 15·2–16·0 oz. γ-isomer per acre and was combine-drilled with the seed at rates ranging from 0·98–3·92 lb./acre crude BHC ≡ 1·9–8·0 oz. γ-isomer per acre. It was also

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applied as a seed dressing at the rate of 2 oz./bushel of a dressing containing 20 per cent technical γ-isomer of BHC. DDT was drilled with the seed at 7·2 lb./acre technical DDT, and ethylene dibromide and D-D were injected into the soil as soil fumigants by means of a special machine at 45·5 lb./acre and 210 lb./acre respectively.

All these treatments gave a marked increase in yield over the control plots in the season following treatment (1947–48). The highest yields were given by the plots treated with ethylene dibromide (32·1 cwt./acre) and BHC broadcast (30·6 cwt./acre) and the lowest by the DDT treatment (20·7 cwt./acre), the corresponding untreated plots producing only 8·9 cwt./acre.

In the following year the plots were sown without further treatment, with the exception of some plots in the second experiment, which were sown with seed dressed with high γ-isomer BHC and one block of nine plots which was set aside for testing for possible taint with BHC treatments.

When judged on their residual effects as indicated by crop yields, plant counts and wireworm populations, BHC broadcast and combine-drilled and the plots combine-drilled with DDT gave the best results. The two soil fumigants were not so effective, and there was no evidence that the BHC seed dressing had any beneficial residual effect.

Taste tests for possible tainting effects in the 1948–49 season, using lettuces, carrots, beetroot and potatoes, indicated that BHC applied to the soil at rates of 1·96 lb./acre and upwards may taint root crops, at least in the second year after treatment. The results are discussed in the light of other work on this subject.

138. Tattersfield, F. & Kerridge, J. R. (1955). The effect of repeated spraying of insects on their resistance to insecticides. III. Conditioning by the administration of sublethal concentrations. *Ann. appl. Biol.* **43**, 630.

The administration of carbon dioxide in sublethal concentrations or for sublethal periods of time gave rise to an increased resistance to its effect in a strain of *Drosophila melanogaster* susceptible to the toxic effects of this gas. The effect did not appear to be permanent.

The successive administration by spraying of sublethal concentrations of DDT and BHC did not increase the resistance of a strain of *D. melanogaster* to their effects, either in the insects sprayed or their progeny. Only when the dosages were such as to give a high death-rate did a significant increase of resistance of the progeny of the treated insects take place; the tendency was, if anything, to increase susceptibility, although the indications were not in favour of DDT acting as a cumulative poison.

In a preliminary series of tests the topical application of DDT in sublethal doses to the adult insects resulted in a reduction in the amount or in the rate of egg laying.

139. Ward, J. & Burt, P. E. (1956). The persistence and fate of DDT on foliage. II. Comparative rates of loss of DDT deposits from glass plates and growing leaves. *Bull. ent. Res.* **46**, 849.

A method is described of applying even deposits of insecticide to leaves without detaching the leaves from the plants. The insecticide is sprayed by hand from an air-operated paint-spray gun under controlled conditions. Using this method for applying the insecticide, the persistence of DDT on living leaves and on glass plates was investigated.

The DDT content of the deposits was estimated chemically by the Schechter–Haller method of analysis, and the toxicity of the deposits was measured by allowing adult *Tribolium castaneum* (Hbst.), confined within glass collars, to crawl on the surfaces to be tested. The deposits were found to be more toxic on leaves than on plates. This difference was shown to be due in part to the greater humidity of the environment during exposure of the test insects to deposits on leaves, as a similar enhancement of toxicity occurred when, during exposure of insects to deposits on glass or Cellophane, the humidity was kept at a higher level than usual.

The rate of loss of toxicity and of DDT when deposits were exposed to sunlight in a greenhouse for varying periods within two different ranges of air temperature was studied. The deposits were derived either from emulsions or crystalline suspensions. At the lower range of air temperatures (10°–

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21° C.) there was a loss, after 37 days, of about one-third of the DDT from suspension-deposits applied at the rate of 2 μg./sq. cm. to either leaves or plates. For deposits on leaves, the losses of DDT indicated by bioassay were about equal to those found by analysis, but for deposits on plates the toxicity after exposure was markedly greater than was to be expected from the amount of DDT remaining. In another experiment within the same temperature range, but with lower rates of deposit, loss of DDT occurred more rapidly, the lower the rate of deposit, the greater being the percentage of DDT lost. Deposits from DDT emulsions included in this experiment behaved similarly to suspension-deposits.

Suspensions were used only with the higher range of air temperatures (15–30° C.), at deposit rates of 2–8 μg./sq. cm. Deposits were lost more rapidly from plates laid on a greenhouse bench than from living leaves, probably because the plates, as a result of insolation, were at a higher average temperature. Again, the lower the rate of deposit the greater was the percentage lost, and the biological activity of the exposed plates, but not the leaves, was greater than was to be expected from the amount of DDT remaining.

It is concluded that the main cause of loss of *p* : *p'*-DDT from crystalline deposits of the pure material exposed to sunlight in a greenhouse is the volatility of the DDT. Since the lower the rate at which the DDT is applied, the greater is the percentage lost in a given time, it is suggested that where maximum persistence of an insecticide is required, and conditions favour loss by evaporation, the insecticide should be applied at the maximum rate practicable.

Loss of toxicity resulting from penetration of DDT into the leaf was too small to be of practical importance.

Entomology Department

140. Banks, C. J. (1955). An ecological study of Coccinellidae (Col.) associated with *Aphis fabae* Scop. on *Vicia faba*. *Bull. ent. Res.* **46**, 561.

141. Banks, C. J. (1955). The use of radioactive tantalum in studies of the behaviour of small crawling insects on plants. *Brit. J. anim. Behav.* **3**, 158.

142. Barnes, H. F. (1955). Gall midges reared from acorns and acorn-cups. *Ent. mon. Mag.* **91**, 86.

A *Contarinia* sp., a *Dasyneura* sp., an inquiline *Clinodiplosis* sp. and a predatory *Lestodiplosis* sp.

143. (Aitkenhead, P.), Barnes, H. F. & Heath, G. W. (1955). Soil sampling for wheat blossom midges. *Plant Path.* **4**, 143.

The difficulty of identifying gall midge larvae makes the rearing of midges from the larvae obtained in soil samples highly desirable.

144. Barnes, H. F. (1955). Avoiding wheat blossom midge attacks. *Plant Path.* **4**, 147.

Shelter from sun and wind afforded by trees and hedgerows and the use of impure seed increase the chances of heavy infestations.

145. Haine, F. (1955). Beobachtungen über das Flugstartverhalten und die Dauer der Flugfähigheit der Männchen von *Periphyllus aceris acericola* Wek. *Anz. Schädlingsk.* **28**, 67.

Males were prevented from flying by winds of 3–5 m.p.h. *P. aceris acericola* maintains capacity to fly for at least 22 days.

146. Haine, E. (1954). Studien und Experimente zur Frage des Populations—und Massenwechsels und des Flugverhaltens virusübertragender Blattläuse. *Anz. Schädlingsk.* **27**, 55.

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147. HAINE, E. (1955). Aphid take-off in controlled windspeeds. *Nature, Lond.* **175**, 474.

A. fabae and *B. brassicae* can take off in winds up to 6–7 m.p.h. Many tree aphids take off only in lower wind speeds of 3–5 m.p.h., and some of these species, unlike those whose flight muscles autolyse, maintain ability to fly for 2–6 weeks.

148. HAINE, E. (1955). The activity of the sycamore aphid, *Drepanosiphon platanoides* Schr. (Hemiptera, Aphididae). *J. anim. Ecol.* **24**, 388.

Take-off and alighting behaviour are described. *D. platanoides* maintains ability to fly for some weeks.

149. HAINE, E. (1955). Biologisch-ökologische Studien an *Rhopalosiphoninus latysiphon* D. Bonn: Bundesministerium f. Ernährung, Landwirtschaft & Forsten. (*Landw.-angew. Wiss.*)

150. JOHNSON, C. G. & TAYLOR, L. R. (1955). The measurement of insect density in the air. *Lab. Pract.* **4**, 187, 235.

An account of the main problems of aerial density measurement and the design and routine operation of suction traps.

151. JOHNSON, C. G., SOUTHWOOD, T. R. E. & ENTWISTLE, H. (1955). A method for sampling arthropods and molluscs from herbage by suction. *Nature, Lond.* **176**, 559.

152. LONG, D. B. (1955). Observations on sub-social behaviour in two species of lepidopterous larvae, *Pieris brassicae* L. and *Plusia gamma* L. *Trans. R. ent. Soc. Lond.* **106**, 421.

Aggregations of the larvae of *P. brassicae* are assisted in their formation and maintenance by the guiding effect of silk trails spun by the larvae. With *P. gamma* aggregation depended on chance larval contacts resulting from similar larval preferences of situation. A sense of larval contact was found to be of prime importance in both species. In *P. brassicae* it was responsible for the establishment of mass feeding rhythms, whilst in *P. gamma* it not only led to aggregation but was also responsible for the production of darker larvae, needing only two or three larvae in association to produce this effect.

153. MURPHY, P. W. (1955). Ecology of the fauna of forest soils. *Soil Zoology. Proc. Univ. Nott. 2nd Easter School in Agric. Sci.*, 1955, 99.

154. MURPHY, P. W. (1955). Note on processes used in sampling, extraction and assessment of the meiofauna of heathland. *Soil Zoology. Proc. Univ. Nott. 2nd Easter School in Agric. Sci.*, 1955, 338.

155. MURPHY, P. W. (1955). Soil faunal investigations. *For. Comm. Rep. on For. Res., 1953–54*, 60.
POTTER, C., HEALY, M. J. R. & RAW, F. (1956). Studies on the chemical control of wireworms (*Agriotes* spp.). I. The direct and residual effects of BHC, DDT, and ethylene dibromide. *Bull. ent. Res.* **46**, 913.

For summary see no. 137.

156. RAW, F. (1955). The effect of soil conditions on Wheat Bulb Fly oviposition. *Plant Path.* **4**, 114.

In a factorial experiment designed to investigate the effects of soil conditions on oviposition, more eggs were laid on plots having a rough tilth than on those having a smooth tilth. More eggs were also laid on plots which were cultivated regularly during the oviposition period. Manuring of the plots had no effect on oviposition.

157. RAW, F. (1955). A Flotation Extraction Process for Soil Micro-Arthropods. *Soil Zoology. Proc. Univ. Nott. 2nd Easter School in Agric. Sci.*, 341.

Earlier wet sieving and flotation methods of extracting arthropods from the soil are reviewed, and a modified technique suitable for micro-arthropods is described. This involves chemical dispersion of the soil, wet sieving, flotation in concentrated magnesium sulphate solution and separation of arthropods from plant material in a plug of frozen benzene.

158. SOUTHWOOD, T. R. E. (1955). The egg and first instar larva of *Empicoris vagabondus* (L.) (Hem., Reduviidae). *Ent. mon. Mag.* **91**, 96.

A description of the previously unknown egg and first larval stage of this Assassin Bug.

159. SOUTHWOOD, T. R. E. The nomenclature and life-cycle of the European Tarnished Plant Bug, *Lygus rugulipennis* Poppius (*Hem., Miridae*). *Bull. ent. Res.* **46**, 845.

Recent taxonomic studies have recognized that *Lygus pratensis* (L.) consists of several species, and other workers have shown that the Tarnished Plant Bug of North America is *L. lineolaris* (P. de B.), a species confined to that continent. Although it is impossible to be certain what species is referred to in all of the earlier works on biology and pest incidence of *L. pratensis* in the Palaearctic region, evidence is given which shows that *L. rugulipennis* Popp. is the more important pest in this region, and it is to this species that the name European Tarnished Plant Bug should be applied. Observations on the life-cycle of *L. rugulipennis* in England have been carried out, and they show that there are normally two generations per year; the second generation becomes adult in the autumn and overwinters in this stage, egg-laying occurring the following spring. This agrees in general with that previously described for *L. pratensis, sens. lat.*

160. (CARVALHO, J. C. M.) & SOUTHWOOD, T. R. E. (1955). Revisão do complexo *Cyrtorhinus* Fieber-*Mecomma* Fieber (Hemiptera–Heteroptera, Miridae), *Bol. Mus. Goeldi*, **11**, 72 + 25 pages of plates.

The Mirid bugs of this complex are of both economic and taxonomic interest; for not only are they important in the biological control of leaf hoppers, especially in the Pacific Islands, but taxonomically they are in a confused state. Keys are given to genera and species, which are mostly redescribed and figured. Two new species of *Tytthus* and three of *Mecomma* are described.

161. STOKES, B. M. (1955). Host plants of wheat bulb fly. *Plant Path.* **4**, 102.

For the first time *Agrostis tenuis, Festuca pratensis, Hordeum murinum, Poa pratensis, Aegilops ovata, Triticum dicoccoides, T. dicoccum* and *T. turgidum* are shown experimentally to be host plants of the wheat bulb fly.

162. STOKES, B. M. (1955). Behaviour as a means of identifying two closely-allied species of gall-midges. *Brit. J. Anim. Behav.* **3**, 154.

Two gall midge species, *Dasyneura violae* and *D. affinis*, which are indistinguishable morphologically, are found to be quite distinct in their host-plant ranges (see p. 132).

163. TAYLOR, L. R. (1955). A tilting micromanometer with continuous sensitivity control. *J. Sci. Instr.* **32**, 173.

A null-reading liquid manometer reads air-speeds of 7·5 feet/second with a Pitot static tube. Sensitivity is highest at zero reading. The highest limits of accuracy assessed were ± 0·2 dyn/sq. cm., i.e., 6·5 feet/second ± 0·5 per cent. The upper reading limit is about 0·7 inches W.G. (50 feet/second).

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Bee Department

General Papers

164. Butler, C. G. (1955). The rôle of "queen substance" in the social organization of a honeybee community. *Amer. Bee J.* **95**, 275.

165. Butler, C. G. (1955). Pest control—without killing the bees. *Agric. Rev., Lond.* **1**, 54.

166. Ribbands, C. R. (1955). The scent language of honeybees. *Discovery*, **16**, 22; (to be reprinted in Smithsonian Inst. Ann. Rep. for 1955.)

167. Ribbands, C. R. (1955). The honeybee. *Sci. Amer.* **193**, 52.

168. Ribbands, C. R. (1955). Bee scents. *Brit. Bee J.* **88**, 96.

169. Ribbands, C. R. (1955). The origin of bee scents. *Brit. Bee J.* **88**, 328.

170. Ribbands, C. R. (1955). Community defence against robber bees. *Brit. Bee J.* **88**, 380.

171. Ribbands, C. R. (1955). Autumn feeding. *Brit. Bee J.* **88**, 432.

172. Ribbands, C. R. (1955). What can a honeybee smell? *Brit. Bee J.* **88**, 600.

(The last five articles were also printed in other national bee journals.)

Research Papers

173. Bailey, L. (1955). Trials with Acaricides at Rothamsted. *Bee World*, **36**, 14.

This short note gives some results of initial experiments with acaricides applied as smokes. The results of continental workers are confirmed, and the apparent superiority of *p*-chlorophenyl, *p*-chlorobenzene sulphonate as an ovicide is noted.

174. Bailey, L. (1955). Control of Amoeba Disease by the fumigation of combs and by fumagillin. *Bee World*, **36**, 162.

The sterilization of combs contaminated with cysts of *Malpighamoeba mellifica* was shown to be possible when acetic acid was used in the way previously described for combs contaminated with Nosema spores.

Fumagillin did not appear to have the striking effect upon an established Amoeba infection as it has upon an infection with Nosema.

175. Bailey, L. (1955). The infection of the ventriculus of the adult honeybee by *Nosema apis* (Zander). *Parasitology*, **45**, 86.

Spores of *Nosema apis* nearly all germinate within 30 minutes of entering the ventriculus, the anterior end of which receives the heaviest initial infection. It is suggested that the parasite is injected into the ventricular cells from the spore via the hollow polar filament.

The central region of the ventriculus receives the lowest initial infection and it seems likely that suppression of infection is linked with the higher concentration of intracellular granules of calcium phosphate found in this region.

176. Bailey, L. (1955). Results of field trials at Rothamsted of control methods for Nosema disease. *Bee World*, **36**, 121.

Erratic results were obtained with fumagillin when fed in syrup in the autumn, and in one trial doses up to 500 mgm. per colony had no significant effect upon the development of the disease during the following spring. Striking success was achieved after colonies had been transferred to combs which had been sterilized with the vapour of acetic acid or of formaldehyde.

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177. BAILEY, L. (1955). The epidemiology and control of Nosema disease of the honeybee. *Ann. appl. Biol.* **43**, 379.

The work done at Rothamsted since 1952 upon this disease is summarized and the experiments leading to the practical methods of control previously reported are described.

178. BUTLER, C. G. (1955). Some recent advances in apicultural research. *Annu. Rev. Ent.* **1**, 281.

A critical review of recent research work on certain aspects of bee behaviour and physiology, including: effects of anaesthetics on adult bees; colony odour; clustering; laying workers; control of queen production; caste determination; division of labour. 108 references are cited.

179. BUTLER, C. G. (1956). Some further observations on the nature of "queen substance" and of its rôle in the organization of a honeybee (*Apis mellifera*) community. *Proc. R. ent. Soc. Lond.* (A) **31**. (In the press.)

Further evidence is given in support of the view that both queen production and the normal inhibition of development of a worker's ovaries are controlled by queen substance; effective extracts of which have now been obtained in a number of organic solvents. It is demonstrated that one way in which this substance is widely distributed amongst the adult members of a colony, after being licked from the queen's body by a few bees, is in regurgitated food. It is also pointed out that queen substance may act indirectly, rather than directly, upon a recipient bee causing the release of a hormone which affects this bee's metabolism.

180. (CARLISLE, D. B.) and BUTLER, C. G. (1955). The "queen substance" of honeybees and the ovary-inhibiting hormone of crustaceans. *Nature, Lond.* **176**, 276.

It has been shown that extracts of honeybee "queen substance" can inhibit ovary development in prawns (*Leander serratus*) whose eyestalks have been removed, and that similar extracts from the sinus glands of female prawns can inhibit ovary development in worker honeybees. It is suggested that a common ovary-inhibiting substance occurs in Arthropoda.

181. FREE, J. B. (1955). Queen production in colonies of bumblebees. *Proc. R. ent. Soc. Lond.* (A), **30**, 19.

Queen bumblebees were induced to found colonies in captivity by confining them with varying numbers of workers and abundant food. When sufficient workers were present to help the queen some of the first eggs she laid gave rise to queens. The factors leading to the production of queens in wild colonies are discussed.

182. FREE, J. B. (1955). The adaptability of bumblebees to a change in the location of their nest. *Brit. J. Anim. Behav.* **3**, 61.

Most of the foragers of a bumblebee colony returned successfully to their nest when it was moved to a new position outside their foraging range. However, if the new site was within their foraging range a high proportion of foragers returned to it, but most of them, at the end of their first foraging trips from the new site, returned to the old site before proceeding to the new one. Their subsequent behaviour varied according to the distance between the old and new sites. Individuals differed greatly in their learning abilities.

183. FREE, J. B. (1955). The division of labour within bumblebee colonies. *Insectes soc.* **2**, 193.

The majority of the workers of a bumblebee colony were found to be either consistent foragers or house-bees, but many performed either task in accordance with the current requirements of their colony. The longer a worker had undertaken household or foraging duties, the more "fixed" she became to the duty concerned.

Foragers showed great constancy to the collection of either pollen loads or nectar loads during consecutive trips, but showed little constancy for

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periods of a day or more. The type of food collected was determined to some extent by colony requirements, which depend on the nature and amount of the food stores possessed by a colony and on the age of its brood.

184. FREE, J. B. (1955). The behaviour of egg-laying workers of bumblebee colonies. *Brit. J. Anim. Behav.* **3**, 147.

A social order, based on dominance, was found to exist in bumblebee colonies. In bumblebee colonies deprived of their queens, and in colonies started by workers alone, animosity occurred between the workers. In each colony one of the workers became the dominant and attacked any of the other workers, although as many as three workers in one colony were seen to attack other bees. The number of attacks was greatest at the time that the social order was established, and thereafter declined. In the majority of colonies the dominant bee had the most developed ovaries, and the bee she attacked most tended to have the next most developed ovaries. The results are discussed in relation to the evolutionary development of bee colonies.

185. FREE, J. B. & BUTLER, C. G. (1955). An analysis of the factors involved in the formation of a cluster of honeybees (*Apis mellifera*). *Behaviour*, **7**, 304.

Individual bees are attracted to a cluster of bees by the stimuli of scent, heat and vibration, which the bees of the cluster produce. Each of these stimuli, provided it is of sufficient magnitude, is by itself sufficient to attract individual bees to join the cluster. Bees are also attracted by the sight alone of actively moving bees. Hungry bees normally prefer to join a cluster of bees from whom they can obtain food, but groups of well-fed bees are more attractive to individual bees than are groups of starving bees, probably because of their greater activity, even when the individual bees are unable to obtain food from them.

186. RIBBANDS, C. R. (1954). Communication between honeybees. I. The response of crop-attached bees to the scent of their crop. *Proc. R. ent. Soc. Lond.* (A), **29**, 141.

Bees from one colony were trained to forage, in equal numbers, from two Petri dishes 50 yards apart. One dish was supplied with sugar syrup scented with benzyl acetate, the other with sugar syrup scented with methyl benzoate.

Training took place after 14.00 hours G.M.T. only, but when the bees had been sufficiently time-conditioned the dishes were put down in the morning. One or other of the two scents was then pipetted into the hive; the addition of the scent to which it had been trained doubled the chance that the bee would visit the feeding-place outside the usual training time. Thus the mere presence of the training scent in the hive, in the absence of either food sharing or dancing, can encourage bees to go to a crop to which they are accustomed.

187. RIBBANDS, C. R. (1955). Communication between honeybees. II. The recruitment of trained bees, and their response to improvement of the crop. *Proc. R. ent. Soc. Lond.* (A), **30**, 26.

Equal numbers of individually marked bees from one colony were trained to forage from each of three Petri dishes placed in different directions from the colony. Dilute sugar syrup was supplied at first, and then replaced by concentrated syrup. The dish at which the supply improved then attracted twice as many recruits as did the dish at which concentrated syrup was always available.

Although the three dishes were only 50–72 yards from the hive, the trained bees were separately recruited to them. Previously trained bees recruited on their first return to the hive, and exposed their scent organs during their second visit to the food source. Individual differences in the behaviour were impressive. The implications of these results are discussed.

188. RIBBANDS, C. R. (1955). The scent perception of the honeybee. *Proc. Roy. Soc.* B, **143**, 367.

By a new technique it has been shown that honeybees can perceive pure chemical scents in great dilution, and that they can distinguish between mixtures which contain only slightly different proportions of the same two scents.

A honeybee was attracted to the body scent which it left behind some time previously on a glass tube on which it had landed momentarily *without* exposing its scent organ; this body scent may often aid bees in their foraging activities.

Amputation of seven terminal segments of both antennae greatly impaired the threshold of scent perception.

The scent perception of the honeybee is compared with that of other insects, and the problems which have not yet been solved are emphasized.

189. Simpson, J. (1955). The significance of the presence of pollen in the food of worker larvae of the honeybee. *Quart. J. micr. Sci.* **96**, 117.

It is shown that worker larvae receive a variable quantity of pollen in their food in summer and sometimes none at all in winter. This pollen probably supplies less than one-tenth of the nitrogen requirements of the growing larvae.

Statistics Department

Research Papers

190. Boyd, D. A. & Lessells, W. J. (1955). Seed-setting for higher profits. *Agric. Rev. Lond.* **1**, 53.

The effect of seed-rate on the yield of potatoes is discussed.

191. Church, B. M. (1955). Weedkillers and insecticides applied to cereals and peas, swedes and kale. *Plant Path.* **4**, 131.

Data from fertilizer surveys carried out in 1954 show that in arable farming districts of Eastern England between a quarter and a half of the cereal acreage was treated with weed-killers. In surveyed districts having less than a third of their acreage in tillage crops, only 10 per cent of the cereals were treated. Formulations of MCPA were used on about 80 per cent of treated fields, the remainder receiving 2, 4-D or DNC weed-killers.

The extent to which various formulations of DNBP were used as weed-killers on peas varied greatly between districts. DDT insecticides were applied to 10–20 per cent of the pea acreage in most areas. In only one district amongst those surveyed was a large part of the kale acreage sprayed or dusted with DDT or BHC insecticides against flea beetle.

192. Church, B. M. (1956). Cereal manuring in England and Wales. *J. Sci. Fd Agric.* (In the press.)

Information on the manuring of cereals obtained from fertilizer practice surveys (1950–54) is presented, and estimates of optimum fertilizer dressings are given for comparison with present practice. Regional differences in manuring, and the influence of previous cropping, the varieties grown, and methods of fertilizer application are considered.

More than a third of the cereal acreage in England and Wales received no nitrogen fertilizers, and the average dressings given were 0·25–0·35 cwt. N/acre compared with a calculated optimum dressing of 0·6 cwt. N/acre. On the available experimental evidence, average potash dressings were about optimal but phosphate fertilizers were used on much of the cereal acreage at rates above the optimum. A third of the nitrogen used on winter cereals was applied in the seedbed in autumn. Due to use of complete fertilizers as top dressings, a sixth of the phosphate and a quarter of the potash used on winter cereals were applied in spring top dressings. About half the phosphate and potash fertilizers used in the seedbed were combine drilled. Profitable increases in the use of nitrogen on that part of the cereal acreage which receives little or no nitrogen would increase the total cereal yields of England and Wales by about 6 per cent.

193. Church, B. M. & Lipton, S. (1956). Use of an electronic computer in the estimation of sampling errors in a nutritional survey. *Brit. J. Nutr.* **10**, 27.

The empirical evaluation of sampling errors of all kinds has in the past been greatly neglected due to the laborious calculations required on desk machines. With the development of electronic methods these computations can now be readily undertaken. The paper describes a method of evaluating the sampling

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errors of a numerical sequence using the electronic computer installed at Rothamsted. The method was developed to deal with the data of a nutritional survey, but the programme has been written in general form and can take account of missing values.

194. CHURCH, B. M., WESTMACOTT, M. H. & (JACOB, F. H.) (1955). A survey of rabbit damage to winter cereals, 1953–54. *Plant Path.* (In the press.)

A country-wide survey of rabbit damage to winter wheat was first carried out in 1951–52. This paper describes a further survey of winter cereals in England and Wales undertaken in 1953–54 to obtain estimates of damage for another year and to extend the results of the previous work. Although myxomatosis was spreading through the country at the time of the survey, it clearly had a negligible effect on the results.

The estimated loss in 1953–54 due to rabbit damage on winter-sown cereals in England and Wales was 1·4 cwt. grain/acre, compared with 1·6 cwt./acre for winter wheat in South and Central England in 1951–52. About a third of the winter-cereal acreage was moderately or severely grazed by rabbits, and the surveyors judged that on over half of this acreage the farmers had no organized policy for rabbit control.

195. (ELLISON, W.), BOYD, D. A. & CHURCH, B. M. (1955). The progress of improvement on upland and hill farms in England and Wales: some results of a recent survey. *J. R. agric. Soc.* **116**, 34.

The results are described of a survey of upland and hill farms undertaken at the request of the Agricultural Research Council and the Ministry of Agriculture in 1953–54. The field work was carried out in Wales and in Northern and South-West England by members of the National Agricultural Advisory Service and the Agricultural Land Service in the provinces concerned. The main objects of the survey were to provide estimates of: (i) the returns from public and private expenditure incurred under the Hill Farming and Livestock Rearing Acts, and (ii) the scope for further improvements on farms eligible for assistance under the Acts.

Farms on about 40 per cent of an estimated total of 4½ million acres on eligible farms in England and Wales had undertaken improvements under the Acts by 1953. The estimated total cost of work approved was £11 million; of this sum about two-thirds was for improvements to farmhouses, cottages, buildings, roads and services, the remainder being for land improvements. Since less than half the approved work had been done, and much had only been recently completed, the full effects on the farm economy could not be measured, but the survey provides a base-line for a more complete assessment at a later date. The surveyors recommended additional improvements at a total cost of £5·6 million on farms with schemes, and improvements on other eligible farms costing £25 million. Factors restricting the improvements likely to be undertaken are discussed.

Owing to lack of accurate information on output in years preceding the survey, provisional estimates of changes in output were derived from assessments of field stock carrying capacity and the numbers of stock on farms. It was estimated that full implementation of all work approved under the Acts might increase annual output by 26,000 two-year-old store cattle or equivalent, and work recommended by the surveyors might give a further increase of 60,000 stores. The estimated return on the total capital investment in improvements was 3–4 per cent per annum, no deduction being made for interest on capital. If grants totalling 50 per cent of the cost were paid in respect of all improvements, the corresponding return to the farmer would be 10–12 per cent of his smaller capital investment.

196. GOWER, J. C. (1955). A note on the periodogram of the Beveridge Wheat Price Index. *J. R. statist. Soc. B.* **17**, 228.

The complete periodogram of the Beveridge Wheat Price Index was calculated on the Manchester University computer. The results were then used to test the goodness of fit of the second-order autoregressive scheme proposed by Sargan.

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197. GRUNDY, P. M., HEALY, M. J. R. & REES, D. H. (1956). Economic choice of amount of experimentation. *J. R. statist. Soc. B.* (In the press.)

This is the detailed version of an earlier paper " Decision between two alternatives—how many experiments ? " of which an abstract appeared in the 1954 report (paper no. 180).

198. HEALY, M. J. R. (1955). A significance test for the difference in efficiency between two predictors. *J. R. statist. Soc. B.* **17**, 266.

If a dependant variate y can be predicted by linear regression on either of two alternative predictors x_1 and x_2, it is natural to measure the efficiency of prediction by the smallness of the residual variance of y. Given a sample of values of y, x_1 and x_2, Hotelling has derived a method of testing whether one predictor significantly exceeds the other in efficiency. This test is derived in a simpler manner and put into a form suitable for computation.

199. HEALY, M. J. R. (1956). The analysis of a factorial experiment with additional treatments. *J. agric. Sci.* (In the press.)

It is often desirable in a factorial experiment to include certain treatments outside the main factorial scheme. The detailed analysis of an experiment of this type is discussed.

200. HEALY, M. J. R. (1956). Weighted probits allowing for a non-zero response in the controls. *Biometrika.* (In the press.)

Black has shown that standard probit calculations can be facilitated by the use of tables of weighted probits. It is shown that the effects of a non-zero response rate in untreated material can be fully allowed for by a slight modification of these tables, and it is pointed out that their use is convenient on automatic high-speed computers.

201. HEALY, M. J. R. & WESTMACOTT, M. H. (1956). The problem of missing values in experiments analysed on automatic computers. *Appl. Statist.* (In the press.)

This article describes a method of handling experimental data with missing values that is sufficiently general to be used in conjunction with any programme for analysing experimental data, and is at the same time simple and satisfactorily fast. The method carries out the calculation of the fictitious values needed to enable the experiment to be analysed in the ordinary way. The calculation is iterative and starts from guessed values for the missing data; at each stage the residual of each missing unit (calculated by the main programme) is subtracted from the value ascribed to that unit at the beginning of the cycle. The process is shown to converge to the required values.

202. HODNETT, G. E. (1956). The responses of sugarcane to fertilizers. *Emp. J. exp. Agric.* (In the press.)

Average standardized responses of plant-canes and ratoons to nitrogen, phosphate and potash were estimated from the results of over 1,000 experiments conducted in British Colonial and Commonwealth Territories since about 1930. The responses (in terms of sugar) were examined in relation to ecological regions within each territory. Responses to organic manure, by-products and lime were also summarized.

Nitrogen responses were observed everywhere. Under irrigation they were usually larger, while the ratoons generally responded more than the plant-canes. No residual response was observed. The sugar percentage was consistently reduced. Sulphate of ammonia appears to be the most effective form of nitrogen.

With phosphate, the responses tended to be associated with soil types. They were generally rather small and similar with successive crops. The effect on the sugar percentage was small and irregular.

Responses to potash were also associated with soil types and to some extent with rainfall. The ratoons tended to give somewhat higher responses than the plant-canes.

Small, positive interactions were found between nitrogen and phosphate and between nitrogen and potash. Pen manure tended to reduce the responses to the main inorganic fertilizers. There was no evidence for interactions between fertilizers and varieties.

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203. HODNETT, G. E. (1956). The use of response curves in the analysis and planning of series of experiments with fertilizers. *Emp. J. exp. Agric.* (In the press.)

The estimation of the parameter k for average response curves of exponential form is briefly discussed. Various methods of estimating standard responses are examined. The efficiencies of experiments of fixed size using different numbers of levels are compared, and considerations affecting the choice of levels are discussed. The importance of the zero level is demonstrated.

204. HODNETT, G. E. (1956). The analysis of a 3×6 experiment arranged in a quasi-Latin square. *Biometrics.* (In the press.)

The analysis of a 3×6 factorial experiment arranged in a 6×6 quasi-Latin square is described, and details are given of a general method for computing the standard errors of comparisons between treatment means adjusted for confounding. The application of this method to the computation of standard errors of treatment comparisons in split-plot designs is indicated.

205. (LE COUTEUR, K. J.) & LIPTON, S. (1955). Non-linear regenerative extraction of synchrocyclotron beams. *Phil. Mag.* **46**, 1265.

To extract a beam of maximum energy from a synchrocyclotron the deflector must be placed at the edge of the magnet, where the magnetic field falls off rapidly and non-linearly with radius. This presents an analytical problem of coupled non-linear differential equations with periodic coefficients. The computer at Rothamsted was used to provide solutions, and it was concluded that a non-linear deflector can extract the beam with higher energy than the linear one at Liverpool. These proposals were primarily intended for the Liverpool and C.E.R.N. synchrocyclotrons, but are being applied to several others. The expected results have already been obtained in Chicago.

206. LEECH, F. B. (1955). Vital statistics in the study of cattle disease. *Agric. Progr.* (In the press.)

Vital statistics may be collected on the farm for the following reasons :

(1) Economic studies in which attention may be focused either on cattle as a source of income or on the losses that result from animal disease.
(2) For studies of the ecology of disease.
(3) To estimate the efficacy of methods of preventing or controlling disease.

Methods appropriate to the particular type of study are discussed in general terms. Various types of survey can provide data suitable for the first two types of study. The third requires field experiments, often on a large scale; problems in the planning and interpretation of these are mentioned.

207. LEECH, F. B. (1955). Contribution to discussion of papers on vital statistics. *Vet. Rec.* (In the press.)

A correct estimate of the incidence of certain diseases is virtually unobtainable, and some of the reasons for this were discussed. It was also pointed out that disease incidence should generally be reported under two headings—percentage of farms affected and the percentage of affected cows on affected farms.

208. LIPTON, S. (1955). A note on the electronic computer at Rothamsted. *Math. Tab., Wash.* **9**, 69.

A short description of the computer is given, together with a few examples of problems that have been solved.

209. PATTERSON, H. D. (1956). A simple method for fitting an asymptotic regression curve. *Biometrics.* (In the press.)

Simple methods for fitting the regression equation

$$y = \alpha - \beta\rho^x, \text{ where } 0 < \rho < 1$$

are suggested for cases in which the ordinates x are equally spaced and take 4, 5, 6 or 7 values.

The estimates of ρ are given by the ratios of two contrasts between the

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values of y. These contrasts are chosen so that the efficiencies of the proposed estimates are high over the range of useful values of ρ.

Once ρ has been estimated α and β can be determined by a straightforward linear regression.

POTTER, C., HEALY, M. J. R. & RAW, F. (1956). Studies on the chemical control of wireworms (*Agriotes* spp.). I. The direct and residual effects of BHC, DDT, D–D, and ethylene dibromide. *Bull. ent. Res.* **46**, 913.

For summary see no. 137.

210. (ROLLINSON, D. H. L., HARKER, K. W., TAYLOR, J. L.) & LEECH, F. B. (1956). Studies in the habits of Zebu cattle. III. Errors associated with recording technique. *J. agric. Sci.* **47**, 1.

To obtain records of individual animals' habits when a small herd is observed for long periods of time, several observers are essential. The errors between observers were so much less than those between animals and between periods of observation that for most purposes records made by a succession of different observers will be adequate.

The errors of observations at 1-minute and 4-minute intervals, using the grazing records of ten animals, were 3·20 and 7·36 per cent of the mean respectively. The latter figure being of sufficient accuracy for practical application, it is concluded that the 4-minute interval is suitable for records of a major habit.

The errors for the minor habits were large relative to the mean time occupied on them, but still reasonable in relation to the purposes for which work of this sort would usually be required.

211. (TANNER, J. M.), HEALY, M. J. R., (LOCKHART, R. D., MACKENZIE, J. & WHITEHOUSE, R. H.) (1955). Aberdeen Growth Study: I. The prediction of adult body measurements from measurements taken each year from birth to five years. *Arch. Dis. Childh.* (In the press.)

A number of children in Aberdeen were measured at each birthday from 0 to 5 years. Eighty of the same individuals have been re-measured as adults, and the paper discusses the prediction of the adult values from those taken in childhood. Among other results, it is shown that the correlation of birth measurements with adult measurements are uniformly small; also that the best age over the range studied for predicting adult values is usually 3 years old, earlier or later information adding very little to the goodness of the prediction.

212. WESTMACOTT, M. H. & REES, D. R. (1955). The feeding of fodder beet to pigs. *J. agric. Sci.* (In the press.)

Data from thirty-eight experiments in Denmark and Britain comparing an all-meal diet for fattening pigs with one containing fodder beet are summarized and the results discussed. The daily intake of starch equivalent, and hence the rate of growth, of pigs given fodder beet is shown to be less than that of pigs given an all-meal ration. Apart from this reduction in rate of growth, it is shown that the value of fodder beet as a food for pigs may be satisfactorily assessed using the starch equivalent system.

213. YATES, F. (1955). The use of transformations and maximum likelihood in the analysis of a set of quantal experiments involving two treatments. *Biometrika*, **42**, 382.

The analysis of sets of quantal experiments with two treatments by the use of transformations and maximum likelihood is discussed, and illustrated by examples, one of which is also treated by large-sample methods. Methods are given for (*a*) obtaining an estimate of the treatment difference in terms of the transformed variate, together with its standard error, (*b*) testing for differences in sensitivity between the different experiments, and (*c*) testing for variation in the treatment difference from experiment to experiment. The appropriateness of various transformations under different circumstances is also considered.

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214. YATES, F. (1955). A note on the application of the combination of probabilities test to a set of 2 × 2 tables. *Biometrika*, **42**, 404.

It is shown that χ^2 without correction for continuity will give one-tail probabilities for 2 × 2 tables which may be safely combined in most cases likely to be met with in practice. The summation of the corresponding signed values of χ gives a rapid method of combination. Reasons are given for believing that combination of probabilities tests are not likely to be very efficient, and this conclusion is demonstrated by a small sampling experiment.

215. YATES, F. & (FINNEY, D. J.) (1955). Report to the Government of India on statistics in agricultural research. *F.A.O. report*, no. 358.

This report has its origin in a visit paid by the authors to India in 1952/3 at the request of the Government of India under the auspices of the Food and Agriculture Organization of the United Nations. The main object of the visit was to advise and assist the Indian Council of Agricultural Research in the teaching and research programme of its Statistical Branch.

The report discusses the organization of statistical assistance that can best serve the needs of the research administrative advisory services and the way in which this organization can be developed. Observations on certain aspects of field experimental work in India are also included, since statistics have much to contribute to the improvement of techniques and the utilization of the results. It is thought that many of the matters discussed in the report will be of interest not only to the various agricultural research organizations in India but also to similar organizations in many other countries.

REVIEW

216. LEECH, F. B. (1955). "British Poisonous Plants", by A. A. Forsyth. *Bull. Minist. Agric. Lond.* 161.

Woburn Experimental Station

217. MANN, H. H. (1956). Weed herbage of slightly acid arable soils as affected by manuring. *J. Ecol.* (In the press.)

The weed herbage growing about the beginning of June was investigated on a greensand soil treated for a series of eight years with large amounts of bulky organic manures, including farmyard manure, sewage sludge and several types of compost. The land was under regular cropping with two market-garden crops per year. The pH value of the soil varied from about 5·0 to about 6·5. The dominant weeds on the whole were *Urtica urens*, *Lamium amplexicaule* and *Capsella bursa-pastoris*, but in the more acid plots *Spergula arvensis* and *Matricaria* sp. were the most frequent. The two last were, however, very rapidly reduced as the acidity decreased, *Spergula* being the most numerous at pH 5·0 or below, and *Matricaria* at just over 6·0.

The effect of the various organic manures on the weed herbage was not widely different, and all increased the weediness by about 30 per cent, farmyard manures less than the other bulky manures. Certain of the weeds, such as *Poa annua*, *Matricaria* sp., *Veronica* sp. and *Chenopodium album*, seem indifferent to the presence or absence of organic manures, while others, like *Urtica urens*, are very much encouraged by farmyard manure, and *Capsella bursa-pastoris* and *Senecio vulgaris* by sewage sludge or composts containing it. Doubling the dressing of manure made little difference to the amount of weeds, except in the case of the annual nettle, where the larger amount of the organic manures produced over 77 per cent more nettle plants per unit area. The addition of sulphate of ammonia to the variously manured plots made very little difference to the weediness of the plots.

In an area where the land is ploughed at least twice a year and regularly cultivated, it seems clear that constant hoeing does not easily rid the land of weeds, and some weeds, like the annual nettles, seem to enjoy it.

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218. MANN, H. H. & BARNES, T. W. (1956). The permanence of organic matter in soil. *J. agric. Sci.* (In the press.)

An experiment at Woburn in which several bulky organic manures were applied in large amounts every year from 1942 to 1950, coupled with two inter-tilled crops a year, gave the opportunity to measure the proportion of the added organic matter that remained in the soil at the end of this period. Four bulky organic manures were used, namely farmyard manure, sewage sludge and two types of compost made with straw and activated with dung or with sewage sludge respectively. They were applied each year in February at two rates, namely 15 and 30 tons of manure per acre.

Examination of the soils at the end of the 8-year period seems to justify the following conclusions. (1) The different materials divide themselves into two classes: farmyard manure in which the organic matter appears to be considerably more active than in any of the other materials used, and the other three manures, which are not widely different, though the least active is the compost made with sewage sludge. (2) Addition of sulphate of ammonia to the bulky manure slightly reduced the rapidity of disappearance of the organic matter except with the farmyard manure. (3) Doubling the amount of manure added has led to disappearance of a larger proportion of the added organic matter after 8 years, except, again, with the farmyard manure.

After 8 years only 50 per cent of the organic matter added is left in the soil when given as farmyard manure: with the other materials the amount remaining in the soil is much greater, going up to nearly 75 per cent with a straw compost made with sewage sludge.

219. DYKE, G. V. (1956). The effect of date of planting on the yield of potatoes. *J. agric. Sci.* (In the press.)

Evidence obtained in the A.I.C. Survey of Maincrop Potatoes 1948–50 and in experiments shows that yields in England and Wales are decreased by delay in planting after about 11 April, at the rate of about 0·4 tons/acre per week. The effect is rather greater in years with fine springs, and on high-yielding fields.

In Rothamsted experiments the responses to dung and fertilizer were all greatly reduced when planting was delayed; between early April and late May the effects of dung, nitrogen and phosphate were halved, while that of potash was reduced by about 80 per cent. The evidence on the responses of different varieties to early planting in English experiments is contradictory, except for an indication that higher-yielding varieties respond better. Data from Craibstone suggests that, if bulk yield is the only criterion, " early " varieties which make rapid growth early in the season have a later optimum planting date than maincrop varieties.

The effect of chitting seed at Craibstone is to increase yields by 1·7 tons/acre for March plantings, but the effect increases for plantings in April and later to 2·5 tons/acre. There is negligible loss of yield from sprouted seed at Craibstone for plantings delayed up to mid-April, but for unsprouted seed there is evidence of a gain from plantings a month earlier. Sprouted seed planted even as late as May 1 yielded as well as unsprouted planted 2 months earlier.

About half the main crop potato acreage of England and Wales in each of the years 1948–50 was planted so late as to suffer appreciable loss of yield. At least one-fifth seems likely to have lost 1 ton/acre or more from delay. The potential increase in national production if all fields were planted by 11 April is equivalent to about 0·5 tons/acre, or 5 per cent of the total production.

Field Experiments Section

220. DYKE, G. V. & MEYLER, S. (1956). Indoor experiments with a combine harvester. *Exp. Husb.* (In the press.)

221. GARNER, H. V. (1955). Manuring of cereal crops. *J. Inst. Corn Merch.* **5**, 12.

Soil Survey of England and Wales

222. The soils of the Glastonbury district of Somerset (Sheet 296). (1955). London: H.M. Stationery Office.

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General Publications

223. Boalch, D. H. (1955). The Commonwealth Agricultural Bureaux and their contribution to world agricultural bibliography. In : *Commun. 3rd int. Congr. Libr., Brussels 1955*, vol. 2A.

224. Ogg, Sir W. G. (1955). The chemist and the farmer. Presidential address delivered at the 74th Annual General Meeting of the Society of Chemical Industry, Birmingham, 12 July 1955. *Chem. & Ind.* 928.

225. Ogg, Sir W. G. (1955). Chemistry and crop nutrition. Ninth Dalton Lecture. *Lect. Inst. Chem.* no. 5.

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