ROTHAMSTED RESEARCH

Rothamsted Report for 1946

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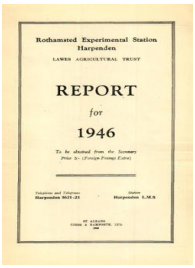

Departmental Publications / Abstracts of Papers

Rothamsted Research

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PUBLICATIONS

Department of Physics

1. KEEN, B. A. 1946. *Report and proposals on agricultural policy and the integration of the work of the departments concerned in soil cultivation.* (Report No. S.2 of 1946, Government Press, Jerusalem.) (Confidential.)

This report was prepared at the request of the Palestine Government. It reviews the present agricultural situation and the methods required to deal with soil erosion and to conserve the land. A development programme and a suitable administrative organisation is presented in some detail.

2. KEEN, B. A. 1947. *Report of the mission appointed to enquire into the production and transport of vegetable oils and oil seeds produced in the West African colonies.* Colonial Office Report No. 211. His Majesty's Stationery Office.

Dr. Keen was Chairman of this Mission, sent out by the home Government. The agricultural, economic and transportation difficulties facing an appreciable increase in vegetable oil exports in the immediate future are discussed in detail, and a number of recommendations are made in all three of these main divisions.

3. KEEN, B. A. 1946. *The agricultural development of the Middle East.* His Majesty's Stationery Office.

This Report embodies a detailed survey of agricultural problems in the fourteen territories that came under the activities of the Middle East Supply Centre. The agricultural, sociological and economic factors in each country are surveyed and a description is given of a number of interior systems of agriculture ranging from the Sudan Plantations Syndicate to the Italian colonies in Libya, all of which, although originating from very different objectives, possess one feature in common: they have found a way round the great obstacle of agricultural improvement that is presented by the traditional and ingrained system of land inheritance and tenure. The conclusion is drawn that no general agricultural development of the Middle East is possible unless these examples are generally followed. Proposals are therefore made for the creation of organisations having the essential features of a Public Utility Corporation. It would then be possible to circumvent difficulties of land tenure without the grave disorganisation that would accompany any effort to change this deeply ingrained feature of the social organisation.

Further sections of the Report deal with the scientific and technical problems of agricultural improvement ranging from soil to livestock and fodder.

The Report concludes with a detailed outline of the functions of a proposed Middle East Council of Agriculture to serve the Middle East as a whole.

4. KEEN, B. A. 1946. *Dr. Löwy's theory of ground-water accumulation.* Phil. Mag., Ser. 7, **37**, 502–504.

This letter is a criticism of the basis of Dr. Löwy's theory. It is shown that his basic assumptions are incorrect as they have not taken account of the physical consequences imposed on water movement in soil by the geometry of its pore-space. A brief exposition is given of these factors, which were worked out in detail and verified at Rothamsted in numerous earlier published papers.

5. SCHOFIELD, R. K. 1946. *Ionic forces in thick films of liquid between charged surfaces.* Trans. Faraday Soc., **42B**, 219-228.

Changes in the thickness of liquid films between solid surfaces play an important part in the swelling and shrinking of many systems.

The equation

$$X = \frac{2}{\nu\sqrt{\beta c_0}} \cot^{-1} \frac{2\sqrt{c_0}}{\Gamma\sqrt{\beta}}$$

has been obtained, in which X is either the thickness of a liquid film adhering to a single solid surface on which there are charged atom groups at surface density Γ, or half the thickness of a film between two such surfaces. In obtaining the equation it is assumed that ions of one kind only, and of valency ν, constitute the diffuse component of the electric double layer, and that these ions are in ideal solution. β is a constant depending on the temperature and the dielectric constant. c_0 is the ionic concentration at the outer surface of the film on one surface or that in the centre of the film between two surfaces. It is considered that the excess hydrostatic pressure

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acting on the film when it is in equilibrium with the bulk liquid at the same height is RTc_0.

The calculated thicknesses of films of water on mica and glass, of hexyl alcohol on glass, and of hexane on steel are in good agreement with the optical measurements of Deryagin and Kussakov. A calculation on the same lines does not satisfactorily reproduce the experimental data for solutions of sodium chloride on glass.

6. PENMAN, H. L. 1946. *Some aspects of evaporation in nature.* J. Royal Coll. Sci., **16,** 117–129.

Rothamsted work during the past twenty-five years is reviewed. From field and laboratory sources, evaporation from bare soil has been shown to be governed by the reluctance of water to move in a soil having only a slight deficit of moisture below field capacity. Under the continuously moist surface conditions of fallow soil in winter it was found possible to estimate evaporation from weather data. With this encouraging sign of order, an analytical treatment has been developed in recent years in terms of the ability of the air to take up more water vapour, and the availability of energy to supply the necessary heat of vaporisation. Experimental work to check these theoretical approaches is described and the results are summarised. Evaporation losses from open water can be estimated from weather data: evaporation from moist, bare soil exposed to the same weather is 90 per cent. of the open water loss in all seasons: transpiration from turf, plentifully supplied with water, is about 60 per cent. in winter and 80 per cent. in summer of the open water loss.

OTHER PAPERS

7. SCHOFIELD, R. K. 1946. *Factors influencing ionic exchange in soils.* Soils and Fertilisers, **9,** 265–266.
8. RUSSELL, E. W. 1946. *Deep ploughing.* Farm Mechanization, **1,** 84–85.
9. RUSSELL, E. W. 1946. *Weather and soil tilth.* Farming, **1,** 131–132.
10. PENMAN, H. L. 1946. *Weather and crops.* Weather, **1,** 169–171.
11. PENMAN, H. L. 1948. *Evaporation in nature.* Reports of Progress in Physics, **11,** 1948. (In the press.)

Department of Chemistry

FERTILISERS AND MANURES

12. COOKE, G. W. 1947. *Fertiliser placement field work.* Agric. Eng. Record, 240–244.

A description of an experimental fertiliser placement drill with a top delivery mechanism built at the National Institute of Agricultural Engineering and an account of its behaviour in field experiments at a number of centres.

13. CROWTHER, E. M., and LEA, F. M. 1946. *Silico phosphate.* Agriculture, **53,** 102–105.

A high temperature product was developed during the war by heating ground mineral phosphate with soda ash and sand in the presence of steam in a rotating furnace of the type used for making cement. The ingredients are first worked into nodules and then heated to 1300–1400° C., powdered coal being used as fuel and care being taken to sinter the nodules and not to melt them. The fluorine present in most mineral phosphate is removed and the remaining ingredients react to give a product which, after grinding, has been given the name "silico phosphate". It contains about 33 per cent. P_2O_5 almost completely soluble in citric acid and highly soluble in ammonium citrate. The phosphoric acid is present as a mixture of calcium silico phosphate and calcium soda phosphate in solid solution.

In comparisons of equal amounts of phosphoric acid silico phosphate gave slightly higher yields of swedes than superphosphate and on the acid soils a considerably larger uptake of phosphoric acid. The two phosphate fertilisers gave closely similar results for potatoes on very acid soils ; superphosphate was slightly superior on the less acid soils.

Manufacture has since been discontinued owing to the necessary reversion of the plant to its original use for cement manufacture.

14. CROWTHER, E. M. 1945. *Unexhausted manurial values: Some aspects needing revision.* Lecture published in Report First Ordinary Meeting, Central Association Agricultural Valuers, 11–18.

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15. CROWTHER, E. M. 1946. *The* 1946 *report on residual manurial values.* Lecture published in Report Second Ordinary Meeting, Central Association Agric. Valuers, 22–29.

16. CROWTHER, E. M. 1946. 1946 *tables and examples of residual manurial values of fertilisers and the manurial values of feeding stuffs.* Published privately by the Central Association of Agricultural Valuers September, 14.

17. CROWTHER, E. M. 1946. *The residual manurial value of fertilisers and feeding stuffs.* J. Roy. Agric. Soc. Eng., **107,** 107–121.

A review of the scientific and experimental background to the problem of estimating residual values or "unexhausted improvements". The results of the early Woburn and Rothamsted experiments are discussed and an interim account given of current Rothamsted experiments on a four-course rotation (Hoos Field since 1932) and on grazing (High Field since 1937). The successive attempts to draw up residual value tables from the first paper of Lawes in 1870 to the Report of a Ministry of Agriculture Conference in 1946 are considered. The recent Report was the first to be accepted by the representative organisations concerned.

18. CROWTHER, E. M. 1945. *Soils and fertilisers.* J. Roy. Agric. Soc. Eng., **106,** 61–73.

A review of recent investigations.

19. CROWTHER, E. M. 1946. *Soils and fertilisers.* J. Roy. Agric. Soc. Eng., **107,** 71–85.

A review of recent investigations.

20. CROWTHER, E. M. 1946. *Modern trends in fertiliser practice.* Published by N.F.U. Lincs. Branch, Programme of Conference, June 14 and 15, 27–32.

MINERAL DEFICIENCIES

21. BREMNER, J. M., HEINTZE, S. G., MANN, P. J. G., and LEES, H. 1946. *Metallo-organic complexes in soil.* Nature, **158,** 790.

Compounds which extract large amounts of polyvalent metals from soils also extract large amounts of organic matter. This suggests that some of the polyvalent metal in soil exists as insoluble co-ordination complexes with part of the organic matter and that the presence of the metals renders the organic matter insoluble in water and in neutral solvents not themselves forming complexes with the metals.

22. DION, G., MANN, P. J. G., and HEINTZE, S. G. 1947. *The "easily reducible" manganese of soils.* J. Agric. Sci., **37,** 17–22.

Factors influencing the "easily reducible" manganese in soils were studied. Pyrolusite and a synthetic manganic hydroxide are "easily reducible" but manganite and hausmannite are "difficultly reducible" forms. The substitution of hydroxylamine hydrochloride for hydroquinone in Leeper's procedure is suggested for simplicity. It gives results of the same general order in ammonium acetate solutions, but slightly higher. Some modification is necessary if it is required to demonstrate the presence of manganese oxides more reactive than pyrolusite.

23. HALE, J. B., and HEINTZE, S. G. 1946. *Manganese toxicity affecting crops on acid soils.* Nature, **157,** 554.

As the result of sand culture experiments Wallace, Hewitt and Nicholas (*Nature,* **156,** 778) showed that the characteristic "field acidity" leaf symptoms of runner beans and cauliflowers are due to toxicity of manganese. Some twenty-five cases of damage to field crops have proved on analysis to be associated with very high concentrations of manganese in the leaves of the plant and low pH values and high exchangeable manganese in the soil. Detailed results are given for eleven pairs of samples from good and bad parts of fields.

24. HALE, J. B., WATSON, M. A., and HULL, R. 1946. *Some causes of chlorosis and necrosis of sugar-beet foliage.* Ann. App. Biol., **33,** 13–28.

The symptoms and characteristics of two virus and one fungus disease and four nutritional disorders of sugar beet which cause chlorosis and necrosis of the foliage are described. The causes of the diseases and methods of distinguishing between them have been investigated by analytical, pathological and field experimental methods.

Experiments in which diagnosis was confirmed by serological and spectro-

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chemical methods show that the two often easily confused diseases, sugar-beet yellows virus and magnesium deficiency, can be visually distinguished.

Sugar-beet yellows virus reduces the potassium, but slightly increases the magnesium content of the leaves.

Magnesium deficiency symptoms are associated with a low magnesium content of the foliage, but may be induced by salt applications without greatly affecting the magnesium analysis.

"Potash" deficiency symptoms are often, but not necessarily, associated with a low potassium analysis and may actually be caused solely by a deficiency of sodium. In the field, symptoms are induced by sulphate of ammonia and phosphate applications and may be prevented in some cases by the application of either salt or muriate of potash, in others by salt only.

Manganese deficiency symptoms are associated with a low manganese content of the leaves, which can be readily increased by spraying or injection with manganese sulphate solution, but a high concentration of manganese in the foliage, such as sometimes occurs naturally on acid soils, has a toxic effect.

25. HEINTZE, S. G. 1946. *Manganese deficiency in peas and other crops in relation to the availability of soil manganese.* J. Agric. Sci., **36,** 227–238.

Crops sensitive to manganese deficiency are generally healthy on soils with more than 0·3 mg. exchangeable Mn per cent., but they may also be healthy on soils with less than this amount.

Other fractions of the soil manganese, including those which are either readily reducible or soluble in sodium hexametaphosphate, are no more successful than the exchangeable manganese in characterizing deficient soils.

Manganese deficiency in crops on a number of fen and other soils was found to occur where the soil had both low exchangeable manganese and high nitrifiable nitrogen.

Sodium hexametaphosphate extracts the total manganese from some fen soils and also the oxidation products from manganese salts added to neutral and alkaline soils.

Pot experiments showed that the control of Marsh spot in peas required an adequate supply of manganese throughout the whole period of seed formation. Manganese accumulated in the plant before flowering is ineffective.

Marsh spot could be induced in peas grown on a soil rich in available manganese by injecting simple inorganic and organic nitrogen compounds into the plant.

26. HEINTZE, S. G., and MANN, P. J. G. 1946. *Divalent manganese in soil extracts.* Nature, **158,** 791.

Evidence was obtained that manganese in alkaline pyrophosphate extracts of soils is in the manganous state. The addition of manganese dioxide before the pyrophosphate extraction greatly increases the soluble manganese, especially in soils of high organic matter. Manganous manganese may exist in co-ordination compounds with soil organic matter but the possibility of its formation by reduction during the extraction cannot be ruled out.

27. HEINTZE, S. G., and MANN, P. J. G. 1947. *Soluble complexes of manganic manganese.* J. Agric. Sci., **37,** 23–26.

Polycarboxylic and hydroxycarboxylic acids as well as pyrophosphoric acid form complexes with manganic manganese which are soluble over a wide pH range. It is suggested that such complex formation may be of importance in maintaining manganese in an available form in soils.

GENERAL

28. COOKE, G. W. 1946. *Where to put the fertiliser.* Farmer & Stock-breeder, **61,** 582.

29. CROWTHER, E. M. 1946. *Salt into sugar.* Farmer's Weekly, **24,** No. 15, 31.

Department of Soil Microbiology

30. KLECZKOWSKA, J. 1945. *The production of plaques by* Rhizobium *bacteriophage in poured plates and its value as a counting method.* J. Bact., **50,** 71–79.

The 'phage studied in this work was derived from garden soil surrounding the roots of peas, and first grown on pea nodule bacteria.

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The quantitative work was carried out by means of plaque counts, using a technique of poured plates.

A statistical examination of this method showed that the modified plaque technique could be so standardized as to make possible reliable estimates by which two or more 'phage suspensions could be compared.

Plaques produced by this method developed in the substance of the agar by the lysis of the minute bacterial colonies developing therein. These colonies ceased to be susceptible to 'phage attack after about 24 hours of incubation at 25° C., thus limiting the plaque size to the volume filled by 'phage diffusion within this time.

Both the number and size of the plaques were affected by the concentration of agar, the composition of the nutrients in the medium, the temperature of incubation, and the age of the bacterial suspension used for plating.

31. KLECZKOWSKA, J. 1945. *A quantitative study of the interaction of bacteriophage with* Rhizobium *using the technique of poured plates.* J. Bact., **50,** 81–94.

When suspensions of 'phage and of live susceptible bacteria are mixed, a constant percentage of the 'phage particles becomes attached to the bacteria. Dead bacteria and live bacteria that are resistant to attack by the 'phage attach to themselves a percentage of the 'phage particles which decreases with increasing 'phage concentration.

When added to a young liquid culture of bacteria, the 'phage commences to multiply within 45 minutes and continues to do so until the culture is cleared and no further bacterial lysis occurs.

The final concentration of 'phage particles reached is independent of the initial dose, but depends on the initial supply of bacteria.

The final 'phage particle numbers are greatly affected by the age of the bacterial culture when infected with 'phage.

When a cleared culture of 'phage and susceptible bacteria is kept for some 5 to 6 days, growth of the bacteria may recommence. This secondary growth consists of susceptible bacteria or of a new dissociant strain resistant to the 'phage.

The repopulation of the previously lysed culture by susceptible bacteria, growing in the presence of 'phage, is made possible by the appearance, during the process of lysis, of some substance that protects the bacteria against 'phage attack.

The resistant dissociant strains of bacteria resembled the parent forms antigenically and were as effective in nitrogen fixation within the host legume. They maintained their 'phage resistance after cultivation in the laboratory up to 2 years. They were readily produced in soil cultures of bacteria treated with 'phage.

When clover, grown aseptically, was infected with a pure culture of a *Rhizobium* strain susceptible to the 'phage, resistant variants appeared in the nodules in the absence of the 'phage.

Among the naturally occurring strains of *Rhizobium* that were tested, only a small proportion of strains of pea or clover nodule bacteria (10 to 15 per cent.) were found to be susceptible to the strain of 'phage studied.

The bearing of the results on the probable effects of 'phage in the soil is considered.

32. KLECZKOWSKA, J. 1946. *The separation of different strains of bacteriophage from a crude culture.* J. Bact., **52,** 25–32.

A number of different strains of 'phage were separated from a crude 'phage S_2P_{11} which was isolated directly from the soil by means of a strain of pea nodule bacteria.

The strains of 'phage differed in host specificity and in the size of plaques produced by them.

Serologically they were related but not identical.

Lytic activity of the 'phage after inhibition by its antiserum could not be regained by dilution beyond the limits of serum activity.

33. NUTMAN, P. S. 1946. *Genetical factors concerned in the symbiosis of clover and nodule bacteria.* Nature, **157,** 463.

In red clover there are hereditary factors which influence the effectivity in nitrogen fixation of the nodules as well as the numbers formed, while others influence the time of first appearance of nodules and the numbers formed without influencing effectivity. Factors influencing the last two non-adaptive characters do not show any marked dominance but this is shown by those

affecting the adaptive character of effectivity. Single recessive genes that influence the effectivity responses are highly specific to a given bacterial strain. A case of complete resistance to infection was shown to be controlled by a recessive gene operating in conjunction with a maternal factor possibly cytoplasmic.

34. NUTMAN, P. S. 1946. *Variation within strains of clover nodule bacteria in size of nodules produced in the "effectivity" of the symbiosis.* J. Bact., **51,** 411–432.

The paper describes experiments on the influence of passage through the host legume and of storage in soil and on agar medium upon the symbiotic behaviour of two strains of *Rhizobium*. The results refer to mean length and "effectivity" of nodules on red clover grown under bacteriologically controlled conditions.

The original culture of the effective strain A was found to be uniform in the behaviour of isolations from replicate colonies, although considerable variation was found between the responses of individual plants infected from the same colony.

Neither plant passage with or without intervening plating or short-time culture on agar nor selection from large or small nodules had any effect on the mean size or effectivity of the nodules produced by strain A.

Plant passage similarly failed to modify the behaviour of the ineffective strain H.K.C.

On the other hand, after the storage of strain A in sterilised Woburn sandy soil ineffective variants were found to constitute a considerable proportion of the bacterial population. These variants resembled the parent type in cultural and serological characters.

After the passage of these ineffective variants through the plant, two reversions to the effective parent type were found among the 13,400 nodules examined. These remained effective on further plant passage.

Stock cultures on agar slopes, both of the effective parent type and of the ineffective variant, showed an occasional tendency to produce new variants in effectivity. Variants in type of growth on agar also appeared under these conditions.

35. SINGH, B. N. 1945. *The selection of bacterial food by soil amoebae and the toxic effects of bacterial pigments and other products on soil protozoa.* Brit. J. Exp. Path., **26,** 316–325.

Amoebae are extremely selective in the type of bacteria that they will eat. Bacteria fall into three groups in this respect: (*a*) those that are edible (partly or completely), (*b*) those that are inedible but whose presence in the environment is not otherwise harmful to protozoa, (*c*) those whose presence alone or in a mixture with edible bacteria is definitely toxic to protozoa.

In a survey of 103 miscellaneous bacteria mostly from soil, those producing red, violet, blue, green or fluorescent pigment were inedible to the protozoa.

Various methods have been devised to show that bacterial pigments of *Chr. prodigiosum*, *Chr. violaceum* and a red bacterium (5654) are toxic to protozoa.

Metabolic products (pyocyanin, crude extract, α-hydroxyphenazine, tea-coloured liquid, fluorescent pigment) of *Ps. pyocyanea* are toxic to soil amoebae, flagellates and ciliates.

The calcium salt of penicillin is not toxic to protozoa even in strong concentrations, while penicillic acid and citrinin seem to be toxic up to a concentration of 1/1500.

36. SINGH, B. N. 1946. *Soil acrasieae and their bacterial food supply.* Nature, **157,** 133.

The genus Dictyostelium is widely distributed in arable soil including those receiving only artificial fertilisers. It can pass through its life cycle in sterilised soil supplied with suitable bacteria whose numbers it greatly reduces.

37. SINGH, B. N. 1946. *A method of estimating the numbers of soil protozoa, especially amoebae, based on their differential feeding on bacteria.* Ann. Appl. Biol., **33,** 112–119.

Describes an improved method for estimating the numbers of protozoa in soil.

38. SINGH, B. N. 1946. *Silica jelly as a substrate for counting holozoic protozoa.* Nature, **157,** 302.

Describes the use of silica jelly in Singh's technique for counting protozoa in soil.

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39. THORNTON, H. G. 1945. *Effective and ineffective strains of legume nodule bacteria.* Nature, **156,** 654.
Reviews recent work at Rothamsted on nodule bacteria.

Department of Botany

40. BRENCHLEY, W. E. 1946. *The role of minor elements in the growth of plants.* Chemical Products, **9,** 61–67.
The early history of our knowledge of the relations between minor elements and plants is outlined in a brief introduction, after which the work done at Rothamsted on the subject since 1906 is reviewed. Copper, manganese, zinc, arsenic, boron, iodine, molybdenum, rubidium, palladium, cobalt, nickel and silicon have all received attention in varying degrees, the work on boron being the most important and comprehensive. It is emphasized that reference has only been made to work done at Rothamsted, which must not be taken to outline the present state of our knowledge of this rapidly expanding subject.

41. WARINGTON, K. 1946. *Molybdenum as a factor in the nutrition of lettuce.* Ann. Appl. Biol., **33,** 249–254.
Lettuce grown in nutrient solution sometimes showed slight benefit on a dry weight basis from the addition of 0·1 p.p.m. Cr, Sr, Ti or V, while Zn was usually harmful. Addition of Mo at a similar concentration, however, exerted such a marked beneficial effect on both yield and appearance as to suggest that this element was essential for healthy growth. Confirmation of the response was not always obtained, and search was made for some factor which would account for the lack of uniformity in the results. Neither the season of the year, the variety, modifications in the nutrient solution, nor the addition of other trace elements appeared to be responsible, and further work is necessary for the elucidation of the problem.

42. BRENCHLEY, W. E. 1947. *The control of wild oats.* Agriculture, **53,** 436–438.
Wild oats have become increasingly troublesome under war-time systems of cultivation, and the native *Avena fatua* is now supplemented by the foreign *A. ludoviciana* which is spreading rapidly. Pulling before the seeds are shed is the best form of control, but under present conditions change in the cropping is the more feasible method. Putting the land under ley is not very successful, as once the wild oat seeds near the surface have germinated, those buried deeper are not brought up into positions more suitable for their growth. Intensive cultivation of root crops, or potatoes, in successive years if possible, is probably the best method of control, coupled with vigilant attention when the land goes back into rotation cropping.

Section of Crop Physiology

43. WATSON, M. A., WATSON, D. J., and HULL, R. 1946. *Factors affecting the loss of yield of sugar beet caused by beet yellows virus. I. Rate and date of infection; date of sowing and harvest.* J. Agric. Sci., **36,** 151–166.
See p. 107.

44. DE ROPP, R. S. 1946. *Studies in the physiology of leaf growth. II. Growth and structure of the first leaf of rye when cultivated in isolation, or attached to the intact plant.* Ann. Bot., **10,** 31–40.
The growth of the first leaf attached to the isolated stem tip of rye was compared with that of the first leaf attached to the intact plant.
Growth of the isolated first leaf was shown to be due to the development of cells already present. In the absence of roots, cell division in the basal meristem of the leaf did not occur.
Growth of the attached first leaf depended mainly on the activity of the basal meristem during the first 3 days after germination.
Differentiation in the attached leaf began at the tip and proceeded towards the base.
No clearly defined meristem was observed in the coleoptile and the growth of this organ seemed mainly due to the elongation of existing cells.

45. DE ROPP, R. S. 1946. *Studies in the physiology of leaf growth. III. The influence of roots on the growth of leaves and stems in rye.* Ann. Bot., **10,** 353–360.

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Experiments were performed to test the effect of roots on the growth of the stem and leaf in rye.

It was shown that, in isolated stem-tips which regenerated roots, continued growth of stems and leaves occurred, whereas in stems which failed to regenerate roots growth was confined entirely to the first leaf of the stem.

The amount of stem and leaf growth was shown to increase with increase in the size of the attached root system.

The effect of the root system on the growth of the stem was found to be attributable only partially to the absorptive action of the root.

Department of Statistics

RESEARCHES IN THEORY AND METHOD

(*a*) *General*

46. JONES, A. E. 1946. *A useful method for the routine estimation of dispersion from large samples.* Biometrika, **33,** 274–282.

Gives a method of estimating the dispersion of a population (in particular, of a normal population) from the difference between the sums of the r highest and of the r lowest values in a large sample of size n. The efficiency of the method in the case of a normal population is fairly high even if r/n is as low as 2–4 per cent.

47. JONES, A. E. 1946. *Approximation processes in mathematical statistics.* (Thesis for Ph.D. degree in the University of London.)

48. QUENOUILLE, M. H. 1947. *On the problem of random flights.* Proc. Cam. Phil. Soc., **43,** 581-582.

S. Chandrasekhar has given an approximate formula for the position of a particle after N random displacements of constant length 1. An exact formula is derived and compared with Chandrasekhar's.

(*b*) *Experimental design and analysis*

49. FINNEY, D. J. 1946. *Recent developments in the design of field experiments.* III. *Fractional replication.* J. Agric. Sci., **36,** 184–191.

When a factorial experiment involves many factors each of which is tested at two levels, economy of space and material may be effected by using only a fraction of a complete replicate of all possible combinations of levels of the factors.

Designs likely to be useful in field experiments are those for six factors in four blocks of eight, for seven factors in eight blocks of eight, and for eight factors in eight blocks of sixteen or in sixteen blocks of eight; in the first of these a two-factor interaction is amongst those confounded, but elsewhere all main effects and two-factor interactions are unconfounded. The method of construction of the blocks, for these designs and those involving more factors, has been described, and an example of the statistical analysis of experimental results (which presents no special difficulties) has been given.

Similar designs can be constructed for experiments with factors at three levels, or indeed at any prime number of levels. Except for a tabulation of the blocks in a one-third replicate of a 3^5 experiment, which confounds two degrees of freedom from a two-factor interaction and otherwise only higher order interactions, no detailed account of these designs has been given here.

50. KEMPTHORNE, O. 1947. *Recent developments in the design of field experiments.* IV. *Lattice squares with split-plots.* J. Agric. Sci., **37,** 156–162.

The testing of a large number of varieties or treatments can generally be most conveniently made by the use of the quasi-factorial designs devised by Yates. The value of such designs is enhanced by the possibility of introducing further treatments on parts of the plots. The present paper describes a lattice square trial testing 25 organic treatments (actually 22 different treatments with a control represented three times) in which all combinations of nitrogen, phosphate and potash were also tested by splitting the plots and confounding the three-factor interaction with whole plots, the total number of split-plots being 300. Both the design and analysis are comparatively simple and straightforward, and will serve as an example of the use of split-plot confounding in most types of quasi-factorial designs.

51. KEMPTHORNE, O. 1947. *A simple approach to confounding and fractional replication in factorial experiments.* Biometrika, **34,** 255-272.

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A method of examining fractional replication and confounding for some types of factorial experiments is described. The formal equivalence between the two is indicated and the implications of this equivalence discussed. Further progress will follow on group theory lines and this is being examined, together with the possibility of fractional replication when the fraction is greater than unity. The possibilities are explored of the estimation of main effects and two factor interactions of many factors by testing only a small proportion of the possible treatment combinations. An examination on these lines is made of designs proposed by Plackett and Burman.

52. KEMPTHORNE, O. 1947. *A note on differential responses in blocks.* J. Agric. Sci., **37**, 245-248.

This paper gives the results of an examination of a series of 128 fertiliser experiments on sugar beet (the factory sugar beet series for the years 1940–45) to see whether there was any evidence of variation in response to the fertilisers in the different blocks. Such variation, if it existed, would seriously complicate the interpretation of confounded factorial experiments. It is shown that, in this series of experiments, there is no evidence of any such variation.

(*c*) *Biological assay*

53. FINNEY, D. J. 1946. *Analysis of a factorial series of insecticide tests.* Ann. Appl. Biol., **33**, 160–165.

When a set of insecticidal toxicity tests yields parallel regression lines for the relationship between mortality probit and log dose, the potencies of the materials or conditions under test may be compared purely in terms of log L.D. 50's. The purpose of this paper is to suggest that, when tests have been made with all combinations of several different factors, standard methods for the statistical analysis of factorial experiments may be adapted to the examination of the relative potencies.

Data obtained by Potter & Gilham (1946) in a 2^3 factorial experiment on alternative storage conditions for insects before and after spraying and the adjuvant action of terpineol in a pyrethrins spray, are used in an example of the computations. Details are given of the test of parallelism of the regression lines, the factorial analysis of the log L.D. 50's, the estimation of the mean effects and interactions and their standard errors, the significance tests, and the preparation of summary tables.

(*d*) *Sampling and sampling surveys*

54. KEMPTHORNE, O. 1946. *The use of the punched card system for the analysis of survey data with special reference to the analysis of the farm survey.* J. R. Statist. Soc., **109**, 284–295.

The paper describes the use of punched cards in the analysis of survey data with particular reference to the National Farm Survey. A brief account of the main features of Hollerith machines is given. The paper also discusses methods of coding, calculation of indices, rents per acre, etc., by the use of master cards and the way in which tabulators can be employed to make counts and to give integrated tabulations when variable sampling fractions are involved.

(*e*) *Other subjects*

55. ANSCOMBE, F. J. 1946. *Linear sequential rectifying inspection for controlling fraction defective.* J. R. Statist. Soc., Suppl. **8**, 216–222.

The paper discusses rectifying inspection, in which the quality of a batch of items is guaranteed by partial or complete inspection of the batch, with replacement of defective items found. A simple sequential procedure is described and compared with the well-known single and double sampling procedures of H. F. Dodge and H. G. Romig.

56. ANSCOMBE, F. J., GODWIN, H. J., and PLACKETT, R. L. 1947. *Methods of deferred sentencing in testing fraction defective of a continuous output.* J. R. Statist. Soc., Suppl. **9**, 198–217.

The paper describes a system of checking the quality of a continuous output by sampling at a small rate and observing any marked increase in the frequency with which defectives are found. The method is applicable to destructive inspection, and does not depend on quality standards being laid down in advance.

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STATISTICAL ANALYSES OF COLLECTIONS OF EXPERIMENTAL AND OBSERVATIONAL DATA

57. BOYD, D. A. 1946. *The manuring of beans and peas.* Emp. J. Exp. Agric., **14,** 195–207.

The results of all available experiments on the manurial requirements of beans and peas in Great Britain are summarized, and some reference is also made to Continental and American literature. The paper also reviews the current manurial practice on farms, obtained from the Survey of Fertiliser Practice.

Beans proved to be highly responsive to farmyard manure and potash and moderately responsive to phosphate; there appeared to be little justification for the use of nitrogen.

Only a small number of experiments have been carried out on peas; they failed to show any consistent reponses to fertilisers. In general neither farmyard manure nor potash were applied to beans, excepting a few counties of Eastern England which dunged their beans. Phosphate was used on almost half the fields and the amount of nitrogen used, although small, was increasing. Manurial treatment of peas is similar to that of beans, but a somewhat greater proportion of the fields received nitrogen and phosphate.

58. CASHEN, ROSE O. 1947. *The influence of rainfall on the yield and botanical composition of permanent grass at Rothamsted.* J. Agric. Sci., **37,** 1–10.

The paper gives the results of a statistical investigation into the effect of rainfall during the growing season on the hay crop (first cut only) of the Park Grass plots.

It is shown that the effect on yields of the total amount of rainfall from 5th March to 8th July in the period 1858–1902 was very substantial on the thirteen plots examined. The average increase in yield for each additional inch of rain varied between 0·7 and 2·4 cwt./acre. The benefit was greatest on the plots dressed with sulphate of ammonia.

The rainfall effects reached a maximum in the latter part of April and early May. There appeared to be no significant differences between the responses of yield to rainfall on the limed and unlimed halves of the plots examined in the period 1920–40.

In the main, the effect of rainfall on the proportions of grasses, leguminous plants and weeds was not significant in the periods 1874–95 and 1920–40.

59. KEMPTHORNE, O., and BOYD, D. A. 1947. *The stock-carrying capacity of farms.* J. R. Statist. Soc., **109,** 469–475.

An examination has been made of the relationship between the numbers of livestock and the cropping of farms, and between the stock-carrying capacity and rental value of land.

The highest rates of stocking per acre of fodder crops, grass and rough grazing were found in the west and north-west midlands and the lowest in the south of England, West Wales and the north-east of England; the rates varied from the equivalent of 25 to over 50 dairy cattle per 100 acres.

Differences in the stock-carrying capacity of land appeared to account almost entirely for any differences in rent. For rents below 40/– per acre a rent difference of 10/– per acre corresponded to a difference in stock-carrying capacity of about 7 dairy cows per hundred acres. The findings of other workers have been examined in the light of these results.

MISCELLANEOUS

60. JESSEN, R. J., BLYTHE, R. H., KEMPTHORNE, O. and DEMING, W. E. 1947. *On a population sample for Greece.* J. Amer. Stat. Assoc., **42,** 357-384.

61. YATES, F. 1946. *The place of statistics in agricultural research.* Agric. Progr., **21,** 1–11.

The paper gives an outline of the ways in which statistics is found to be of assistance in agricultural research with the object of indicating to those not familiar with recent developments when it is worth while consulting an expert.

62. YATES, F. 1946. *Agriculture and the food crisis.* Article published in "Contact".

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Department of Plant Pathology

VIRUS DISEASES

REVIEWS

63. BAWDEN, F. C. 1946. *Virus diseases of plants* (Cantor Lectures). J. Roy. Soc. Arts, **154,** 136.

64. BAWDEN, F. C. 1946. *Virus diseases.* Farming, **1,** 71.

65. WATSON, M. A., and HULL, R. 1946. *Sugar beet yellows.* Adv. Leafl. Minist. Agric., **323.**

SCIENTIFIC PAPERS

66. BAWDEN, F. C., and KASSANIS, B. 1946. *Varietal differences in susceptibility to potato virus Y.* Ann. Appl. Biol., **33,** 46.

In addition to giving different kinds of symptoms when infected with potato virus Y, individual potato varieties also differ in their susceptibility to infection, in the concentration of virus attained in their sap, and in their efficiency as sources of virus for aphides. Their relative susceptibility in the open when exposed to equal chances of infection is correlated with the ease with which they become infected when colonized with infective aphides, and can be assessed from tests made under glass. Methods for making such tests are described; these need few tubers and give reproducible results. It is considered that they could be applied in studying the inheritance of this type of resistance and to test the behaviour of new seedlings. The American variety Katahdin was the most resistant of those tested, but there were significant differences between commercial British varieties.

In the open, all varieties were equally colonized by aphides and resistance to infection with virus Y was not correlated with resistance to leaf roll.

67. BAWDEN, F. C., and KASSANIS, B. 1947. Primula obconica, *a carrier of tobacco necrosis viruses.* Ann. Appl. Biol., **34,** 127.

A tobacco necrosis virus has been isolated from the leaves and flowers of naturally-infected *Primula obconica* plants. Although the virus produces no necrotic symptoms, it is not distributed uniformly through the plants, but occurs only in isolated regions, most of the tissues being apparently virus-free.

When inoculated to healthy primulas, three tobacco necrosis viruses were found to behave similarly. They all enter and multiply locally, but produce no symptoms; movement from the inoculated areas occurs only rarely and then does not cause a full systemic infection but only further localized infections. Multiplication of the viruses in primula is slower than in tobacco or French bean, which react necrotically.

68. BAWDEN, F. C., and PIRIE, N. W. 1946. *The virus content of plants suffering from tobacco mosaic.* Brit. J. Exp. Path., **27,** 81.

Virus can be released from the leaf residues of plants suffering from tobacco mosaic by fine grinding, or by incubation with either trypsin or the mixture of enzymes from snails' crops. Grinding causes loss of virus, and more virus is obtained if incubation with trypsin precedes grinding than if the operations are reversed. Most virus is released by incubation with the snail enzymes. Successive incubations are needed to release all the virus from the residues; this may amount to one-third of the total insoluble nitrogen of the leaf. The total virus in the leaves accounts for 10 per cent. of their dry matter; less than a third of the virus is obtained in the sap, but this is the more infective.

69. BAWDEN, F. C. and ROBERTS, F. M. 1947. *The influence of light intensity on the susceptibility of plants to certain viruses.* Ann. Appl. Biol., **34,** 286.

Reducing the light intensity under which plants were grown in summer to one-third increased their susceptibility to infection with tobacco necrosis, tomato bushy stunt, tobacco mosaic and tomato aucuba mosaic viruses. With the first two viruses shading increased the average number of local lesions per leaf by more than ten times and by more than five times with the second two.

Reducing the light intensity increased the virus content of sap from leaves inoculated with Rothamsted tobacco necrosis virus by as much as twenty times. As it also reduced the total solid content of sap by about one half, purification was greatly facilitated; crystalline preparations of the virus were readily made from shaded plants but not from unshaded controls.

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Reducing the light intensity also increased the virus content of systemically infected leaves; the greatest effect was with tomato bushy stunt virus with which increases of up to ten times were obtained, but with tobacco mosaic and aucuba mosaic viruses there were also significant increases.

The importance of controlled illumination in raising plants for virus work and the possible mechanisms responsible for the variations in susceptibility are discussed.

70. BROADBENT, L. 1946. *Alate aphides trapped in N.W. Derbyshire, 1945.* Proc. R. Ent. Soc. Lond., **21,** 41.

Six adhesive traps were operated throughout the summer in the Peak District of Derbyshire. A total of 23,040 aphides were trapped and most were identified. The numbers of each species per trap are given, together with the periods of flighting. Three traps were situated in potato fields at altitudes over 1,000 ft., three in potato fields under 500 ft. The latter traps caught more than twice the number of aphides trapped at the higher altitudes, and more species were represented at the lower levels.

71. BROADBENT, L. 1946. *Egg-laying by* Corymbites cupreus *latreille (Col. Elateridae).* Ent. Mon. Mag., **82,** 301.

A note describing the times of egg-laying and hatching, and the numbers of eggs laid by an upland click beetle.

72. BROADBENT, L. 1946. *Note on the effect of wireworms of the genera* Agriotes *and* Corymbites *on crop yields.* Ann. Appl. Biol., **33,** 166.

Experiments were made to illustrate the regular falling off of yield of crops due to increasing wireworm populations under controlled conditions. The genus *Corymbites* was shown to cause as much damage as *Agriotes*; *Athous* was less harmful. The damage caused to various cereals by *Agriotes* is contrasted.

73. BROADBENT, L. 1946. *A survey of potato aphides in north-west Derbyshire,* 1945. Ann. Appl. Biol., **33,** 360.

Counts of aphides infesting potato crops in the Peak District of Derbyshire were made during the summer of 1945. *Myzus persicae* Sulz. was common on almost all crops, and peak figures on some reached over 1,500 per 100 lower leaves.

On many fields two peaks were noted, one towards the end of July and the second in mid-September, and in some fields there were still heavy infestations when the haulms died. The number of aphides varied considerably from field to field; sheltered fields were the least infested. In this area in 1945 there was no evidence to suggest the contention that the altitude and aspect of the field have any influence on the intensity of infestation. Tuber samples from some of the fields indicated that there was a large spread of leaf roll virus during the year.

74. CROOK, E. M., and SHEFFIELD, F. M. L. 1946. *Electron micrococoscopy of viruses.* I. *State of aggregation of tobacco mosaic.* Brit. J. Exp. Path., **27,** 328.

Preparations of purified tobacco mosaic virus separated according to Bawden and Pirie's (1945) method of differential ultracentrifugation have been examined in the electron microscope. Micrograms of the most slowly sedimenting fraction (A) contain particles most of which are no longer than their diameter (15 μ), and these particles are compared with the spherical viruses, tobacco necrosis and tomato bushy stunt. As sedimentation rate increases (types B–D) the specimens contain rods of increasing length. Micrograms of crude sap show rods mixed with other plant constituents. Keeping the virus for 3 weeks at 4° C. causes some particles to aggregate, and aggregation proceeds further during treatment with phosphate. Heating under certain conditions to 60° C. or more or incubating at 37° C. with trypsin produces many rods longer than 5 μ. Drying causes no serious disaggregation.

Particle length varies also in potato X virus.

In no preparation of a rod-shaped virus were the particles all of uniform length, and in tobacco mosaic virus some particles of the A-type were always present. All evidence indicates that average rod length is dependent on preparative treatment.

75. DONCASTER, J. P., and KASSANIS, B. 1946. *The shallot aphis,* Myzus ascalonicus *Doncaster, and its behaviour as a vector of plant viruses.* Ann. Appl. Biol., **33,** 66.

A new species of aphis, *Myzus ascalonicus* Doncaster, is briefly described,

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and compared with *Myzus persicae* Sulz., which it resembles superficially. It has been found on shallots in storage and on onions and other species of plants both in glasshouses and in the open between October and June. Its summer habits and hosts are unknown. In comparative virus transmission tests with *M. persicae* it was found that *Myzus ascalonicus* transmits dandelion yellow mosaic virus, which is not transmitted by *Myzus persicae*; and also cucumber virus I, *Hyoscyamus* virus III and sugar-beet yellows virus, all of which are transmitted by *M. persicae*. *Myzus ascalonicus* does not transmit the viruses of potato Y, severe etch, lettuce mosaic and sugar-beet mosaic which are transmitted by *Myzus persicae*.

76. HALE, J. B., WATSON, M. A., and HULL, R. 1946. *Some causes of chlorosis and necrosis of sugar-beet foliage.* Ann. Appl. Biol., **33,** 13.

The symptoms and characteristics of two virus and one fungus disease and four nutritional disorders of sugar-beet which cause chlorosis and necrosis of the foliage are described. The causes of the diseases and methods of distinguishing between them have been investigated by analytical, pathological and field experimental methods.

Experiments in which diagnosis was confirmed by serological and spectrochemical methods show that the two diseases frequently confused, sugar-beet yellows virus and magnesium deficiency, can be visually distinguished.

Sugar-beet yellows virus reduces the potassium, but slightly increases the magnesium content of the leaves.

Magnesium deficiency symptoms are associated with a low magnesium content of the foliage, but may be induced by salt applications without greatly affecting the magnesium analysis.

"Potash" deficiency symptoms are often, but not necessarily, associated with a low potassium analysis and may actually be caused solely by a deficiency of sodium. In the field, symptoms are induced by sulphate of ammonia and phosphate applications and may be prevented in some cases by the application of either salt or muriate of potash, in others by salt only. Some interchangeability of the functions of potassium and sodium in the plant is suggested.

Manganese deficiency symptoms are associated with a low manganese content of the leaves, which can be readily increased by spraying or injection with manganese sulphate solution, but a high concentration of manganese in the foliage, such as sometimes occurs naturally on acid soils, has a toxic effect.

77. KASSANIS, B. 1947. *Studies on dandelion yellow mosaic and other virus diseases of lettuce.* Ann. Appl. Biol. **34,** 412.

The symptoms caused by dandelion yellow mosaic virus on cultivated lettuce, *Lactuca serriola* and *L. virosa* are described and compared with those caused by lettuce mosaic virus.

Lettuce is much more susceptible than dandelion to the yellow mosaic virus; no infections of dandelions were obtained by mechanical inoculation and only three by aphides, whereas infection of lettuce is regularly obtained by aphides and by inoculation provided an abrasive is used. *Myzus ornatus*, *M. ascalonicus* and *Aulacorthum solani* transmitted dandelion yellow mosaic virus but not lettuce mosaic virus, whereas *M. persicae* transmitted the latter but not the former. *Nasonovia ribicola*, the common lettuce aphis, transmitted neither. Aphides became infective only after feeding periods of some hours on the diseased plants and ceased to be infective within an hour of the infective feeding. Their efficiency as vectors was not increased by a preliminary starving period, as happens with *M. persicae* and lettuce mosaic virus. Lettuce mosaic virus was found in most samples of commercial seed, which explains its prevalence; no evidence was found for the seed-transmission of dandelion mosaic virus and it is doubtful if it occurs, for infected lettuce are so severely affected that they rarely set seed.

Cucumber mosaic virus was isolated from naturally infected lettuce.

78. KLECZKOWSKI, A. 1946. *Combination between different proteins and between proteins and yeast nucleic acid.* Biochem. J., **40,** 677.

Combinations of tobacco mosaic virus with different proteins and with yeast nucleic acid were studied. Proteins with different isoelectric points were used. They included ribonuclease, globin, clupein, serum albumin and serum globulin. Combinations of some of these proteins with each other and with the nucleic acid were tested for comparison with the virus.

When solutions of some pairs of these materials were mixed at pH values at which they were oppositely charged they precipitated each other; most

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of the precipitates could be dissolved by adding NaCl. The behaviour of tobacco mosaic virus did not differ from that of other proteins. The addition of 0·3 *M* NaCl to mixtures of tobacco mosaic virus with clupein, globin and ribonuclease separated 20–90 per cent. of the materials previously combined.

Suspensions of heat coagulated proteins behaved similarly to protein solutions; they could be flocculated by solutions of oppositely charged nucleic acid or clupein; some oppositely charged suspensions also flocculated one another. At pH values remote from their isoelectric points suspensions combined with solutions of other proteins or of nucleic acid if their charges and those of the suspensions were of opposite sign; these combinations could be split to varying extent by adding 0·3 *M* NaCl. There are also indications that electrically charged suspensions can attract protein molecules carrying no net charge.

The inhibiting effects of ribonuclease, globin and clupein on the infectivity of tobacco mosaic virus at pH 6·0 were diminished by 0·3 *M* NaCl. Changing the pH from 6·0 to 9·0 reduced the inhibiting effects of ribonuclease and globin, but it did not influence the effect of clupein; it also considerably reduced the amount of ribonuclease or globin combined with the virus, but had no effect on its combination with clupein.

No evidence was found for the existence of any specific affinity responsible for combination between tobacco mosaic virus and ribonuclease. Combination seems to depend largely on electrostatic forces of attraction and be affected by NaCl in the same way as combinations of each of the two with other proteins or with nucleic acid. The only fact which could be interpreted as an evidence for the existence of such specific affinity was that the enzyme inhibited infectivity of the virus much more strongly than did other tested proteins, which also combined with the virus.

Combination of nucleic acid and protein with other proteins differed from adsorption by charcoal in that it was conditioned by the sign of their electric charge, whereas adsorption by charcoal is not.

Irrespective of the sign, an increase in the charge of these materials caused a decrease in their adsorption by charcoal.

79. Roberts, F. M. 1946. *Underground spread of potato virus X.* Nature, Lond., **158,** 663.

The spread of potato virus X by leaf contact has been confirmed and spread by root contact demonstrated for the first time. Rate of spread in potatoes is slow; tubers from plants adjacent to infected ones often become infected although the haulms of these plants failed to react positively for virus X, suggesting that spread was occurring underground. Glasshouse experiments to test this possibility were made with potatoes and tomatoes; healthy and infected plants were grown in the same pots, in half of which foliage contact was prevented by screens. Too little spread occurred with potatoes for any definite conclusions, though there was one infection in a screened pot, but with tomatoes there was abundant evidence of underground spread. In one experiment there were 5 out of 9 infections in screened pots compared with 7 out of 9 in the unscreened, and in another 9 out of 9 infections in the screened pots compared with 7 out of 9 in the unscreened. There is as yet no evidence to show whether underground spread is caused by mechanical transfer of virus between roots in contact, or by some other mechanism.

80. Watson, M. A. 1946. *The transmission of beet mosaic and beet yellows viruses by aphides; a comparative study of a non-persistent and a persistent virus having host plants and vectors in common.* Proc. Roy. Soc., Lond., B, **133,** 20.

The vectors of beet mosaic virus are optimally infective when they have fed for only a few minutes on the infected plants after a period of fasting. After infection feeding, infectivity is very rapidly lost when the vectors feed on healthy plants, but while it remains a single vector can infect several plants. Infectivity is lost much more slowly when the vectors fast after infection feeding.

In this behaviour beet mosaic virus resembles Hy 3, potato Y, cucumber 1, and other aphis-transmitted viruses which have been called the non-persistent group. It resembles these viruses also in its physical properties.

In some secondary characters beet mosaic differs from the other non-persistent viruses more than they differ from each other. It is retained longer by the fasting vectors, and infectivity of the vectors may increase considerably with increasing infection feeding time, in the absence of preliminary fasting, though it rarely reaches the optimal level.

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With beet yellows virus infectivity of the vectors is not affected by preliminary fasting, but always increases with increasing feeding time on both infected and healthy plants. Infectivity increases with increasing feeding time on the healthy plants whatever the infection feeding time, and therefore there is always a delay in the production of optimum infectivity by the aphides after cessation of infection feeding. Infectivity is more rapidly lost from the fasting than from the feeding vectors.

The properties indicate that beet yellows belongs to the persistent group of viruses, although its persistence in the fasting vectors is only about the same as that of beet mosaic, which is a non-persistent virus. The main basis of distinction between the two types seems not to be the time for which they are retained by vectors, but the effect of preliminary fasting.

Beet yellows and beet mosaic viruses have the same vector and host plant and therefore the differences in their behaviour are properties of the viruses themselves, and are not induced by the conditions in which they are transmitted.

81. WATSON, M. A., WATSON, D. J., and HULL, R. 1946. *Factors affecting the loss of yield of sugar beet caused by beet yellows virus. I. Rate and date of infection; date of sowing and harvesting.* J. Agric. Sci., **36**, 151.

Field experiments were carried out to measure the effect on the yield and composition of sugar beet of infection with beet yellows virus, and to determine how the effect varies with rate and date of infection and with date of sowing and harvesting of the crop.

Control measures designed to prevent spread of infection within experimentally infected plots and introduction of infection from sources outside the experiment were not completely effective. Consequently the numbers of plants which became infected differed from those prescribed by the experimental treatments. The effects of infection were, therefore, estimated by means of regressions on the numbers of plants observed to become infected on successive dates.

After correcting the observed yields for accidental infections by means of the regression coefficients, it was found that the effect of infection on the yield of sugar was linearly related to the rate of infection, i.e. the loss of yield of sugar caused by infection was proportional to the percentage of infected plants. There was no compensation for loss in infected plants by increased growth of healthy neighbours.

The effect of infection on yield of sugar decreased linearly with later date of infection, falling to values not significantly different from zero at the date of harvest. The loss of yield caused by infection was therefore approximately proportional to the interval of time between the date of infection, as shown by the appearance of symptoms, and the date of harvest. The loss of yield per 1,000 plants per week of infection was about 10 lb. of sugar, or about 5 per cent. of the yield of healthy plants. Very late infections, producing symptoms shortly before harvest, had an apparently beneficial effect on yield, but this is thought to be a spurious effect attributable to a tendency of small plants to escape natural infection.

Variation in the date of sowing had little effect on the loss of yield of sugar, but as late sowing reduced yield, it increased the percentage of loss caused by infection. Late-sown crops were more susceptible to natural infection than early-sown crops.

The greatest loss of yield occurred on plots where all plants were infected at the earliest date, at the end of June, and showed symptoms in July. In one experiment this treatment caused a loss of about 36 cwt. sugar/acre, and in another 24 cwt./acre, 72 and 46 per cent. respectively of the yields of uninfected plots.

No significant variation in the effect of infection with change in the date of harvest was found. There was evidence that while the effect of very early infections was similar for early and late harvests, the effect of later infections increased when harvest was delayed. Infections which produced symptoms at any time between July and early September had approximately the same effect on crops harvested in late November or December.

The effects of infection on yield of tops and roots were similar to, but relatively smaller than, those on the yield of sugar.

The sugar content of the root was reduced by infection by 1–2 per cent. of fresh weight. Infections in August, which produced symptoms in September, had a slightly smaller effect than those made earlier. Th

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noxious nitrogen content was apparently increased by infection, but the estimates of this effect had large standard errors and were not significant.

MYCOLOGY

REVIEWS

82. GARRETT, S. D. 1946. *Soil as a medium for transfer and multiplication of disease organisms.* Soil Sci., **61,** 3.

83. GARRETT, S. D. 1946. *Reduction of take-all by artificial fertilisers.* J. Minist. Agric., **53,** 223.

84. GLYNNE, MARY D., and MOORE, F. J. 1946. *Eyespot and lodging of wheat.* J. Minist. Agric., **53,** 305.

SCIENTIFIC PAPERS

85. GARRETT, S. D. 1946. *A study of violet root rot. Factors affecting production and growth of mycelial strands in* Helicobasidium purpureum Pat. Trans. Brit. Mycol. Soc., **29,** 114.

For this investigation potato tubers were inoculated with 8·5 mm. disks cut from a growing colony of *Helicobasidium purpureum* on meat-malt extract agar, and buried in glass jars filled with soil; maximum growth of mycelial strands from the inoculum disk was measured after some seven weeks by a paper scale fitted to the curved surface of the tuber.

The distance covered by mycelial strands and the frequency of infection cushions decreased with increase in storage age of the tuber. Inoculum disks cut from the growing margin of the fungus colony (marginal disks) were less effective for production and growth of strands than disks cut within a circle drawn 8·5 mm. from the margin (submarginal disks). The greater effectiveness of submarginal disks was related to their greater mycelial density; progressive development of mycelium within the marginal zone of the fungus colony was due to infiltration of new hyphae from the submarginal zone, as well as to branching of the original hyphae within the marginal zone. Production and growth of strands also increased with concentration of nutrients in the agar, and especially with that of the malt constituent. With increase in age of the colony to five or six weeks at 25° C., the potency of inoculum disks for strand production declined, but this apparent staleing effect did not occur with disks cut from colonies on double depth agar (6 mm.). Transfer of colonies after three or four weeks' growth at 25° C. to laboratory temperature (15–20° C.) for a further 1–2 weeks reduced strand growth from disks more severely than did continued incubation of the colonies at 25° C. for the same period.

Growths of strands was greater in a 1 soil : 3 sand mixture than in soil. Soil acidity depressed strand growth at medium and low but not at high soil moisture content, and not in the soil/sand mixture. This adverse effect of soil acidity was also shown in growth of mycelium over Rossi-Cholodny slides.

86. GARRETT, S. D. 1946. *A multiple-point inoculating needle for agar plates.* Trans. Brit. Mycol. Soc., **29,** 171.

A ten-point inoculating needle was constructed as follows: Ten 15 cm. lengths of steel wire, No. 20 gauge, were cut, and one end of each was hammered out flat on an anvil. Each length of wire was bent through an angle of 60° at a distance of 6 cm. from the flattened end, and then through an angle of 90° in the reverse direction at a distance of 10 cm. from the same end, both angles being in the plane of the flattened tip of the wire. The ten lengths of bent wire were then clamped to a wooden holder, in which grooves had been cut, to give the finished instrument. The needle was used as follows: From the inverted inoculum plate, disks previously cut with a sterile cork borer were removed one by one until all ten points were occupied. The ten disks were then transferred one by one to the inoculated plate, which was also held upside down during the operation to exclude contaminants.

87. GREGORY, P. H., and GIBSON, GORDON W. 1946. *The control of narcissus leaf diseases.* III. Sclerotinia polyblastis *Greg. on* Narcissus tazetta *var. Soleil d'Or.* Ann. Appl. Biol., **33,** 40.

In the extreme south-weat of England *Narcissus tazetta* grown for the outdoor flower crop is regularly attacked by narcissus fire (*Sclerotinia polyblastis*). A randomized strip experiment on the variety Soleil d'Or laid down in 1937, in which half the plots were sprayed each season, gave data on the effect of controlling this disease on the number and quality of flowers

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produced in 1939, 1940 and 1941, and on the weight and grade of bulbs lifted in 1941.

There was an average increase of 26 per cent. in the number of flowers produced on sprayed plots, and a 35 per cent. increase in weight of bulbs. There was no evidence of a cumulative improvement because most of the gain in one year appears to have been immediately expended in increased flowers in the following season, but the sprayed plots maintained a higher general level throughout. The quality was improved by spraying, mainly by the addition to the inflorescence of an average of one extra "bell". Although not cumulative, there was a residual effect shown by the increased yield of bulbs in 1941 after a season in which only one post-flowering spray had been applied.

The effect of treatment on the date of flowering (anthesis) was negligible and its direction depended on the season. In this respect Soleil d'Or differs from Golden Spur, in which spraying induced the marked retardation of flowering noted in 1938 and 1939.

Department of Biochemistry

88. Crook, E. M. 1946. *The extraction of nitrogenous materials from green leaves.* Biochem. J., **40,** 197–209.

A process for extracting 90–95 per cent. of the nitrogenous material from tobacco leaves is described.

The steps in this process are: preliminary mincing and washing, grinding in a triple-roller ointment mill, extraction with dilute sodium hydroxide at pH 8·0, repetition of grinding and extraction.

The triple-roller mill is effective because of the rubbing to which it subjects the leaves.

The salt concentration must be minimal for best extraction; buffers and compounds preventing the precipitation of Ca-complexes reduce extraction.

Regrinding of separated chloroplastic material with partially extracted leaf fibre decreases rather than increases the extraction of protein.

Grinding under Lugg's (1939) conditions was found to be less effective with tobacco leaves than the process described here.

All grinding methods have the disadvantage that they cause some degree of alteration of the proteins. Nevertheless, the high extractions here reported have been obtained under conditions less likely to cause grave alteration to the proteins than any so far reported in the literature.

Approximate calculations based on the extraction give the average protein content of tobacco leaves to be 15 per cent. of the dry matter, of which 95 per cent. is extractable.

89. Holden, M. 1946. *Studies on pectase.* Biochem. J., **40,** 103–108.

Pectase activity was determined by estimating the amount of methanol liberated from pectin under standard conditions.

The sap of tobacco leaves contains only a small proportion of the total pectase present, most being associated with the fibre.

Extraction of the enzyme is influenced by salt concentration and pH. The enzyme in the extract could be concentrated by precipitation with ammonium sulphate at 65 per cent. saturation from a buffer solution of pH 7, but not with ethanol. An increase in specific activity or enzyme preparations was obtained by removal of the protein precipitated at pH 4·6 in the presence of salt. The adsorption of pectase on Celite from salt-free solution was confirmed, and elution with 0·2 M-Na_2HPO_4 was more effective than with NaCl.

The optimum conditions for enzyme activity were found to be pH 8 and 55°. Acidification to pH 3 and heating to 80° destroyed the enzyme.

The pectase content of tobacco leaves was influenced by manurial treatment. The distribution in the leaves of ten other species is given.

90. Lees, H. 1946. *Effect of copper-enzyme poisons on soil nutrification.* Nature, **158,** 97.

The results suggest that copper and/or some allied elements play an important part in the oxidation of ammonium ions in soil by the soil microflora.

91. Pirie, N. W. 1946. *The manometric determination of formic acid.* Biochem. J., **40,** 100–102.

A technique for the manometric estimation of the CO_2 produced by the

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oxidation of formic acid by mercuric chloride is described. It is suitable for 1·0–0·1 mg. quantities.

The rates of formation of formic acid from agar and *Brucella abortus* antigen are compared.

Department of Entomology

92. BARNES, H. F., and WEIL, J. W. 1945. *Slugs in gardens: their numbers, activities and distribution. Part* 2. J. Anim. Ecol., **14,** 71–105.

93. BARNES, H. F. 1946. *Gall midges of economic importance.* Vol. I. *Gall midges of root and vegetable crops.* 104 pp., 10 plates (4 in colour). London: Crosby Lockwood & Son, Ltd.

94. BARNES, H. F. 1946. *Gall midges of economic importance.* Vol. II. *Gall midges of fodder crops.* 160 pp., 4 plates (1 in colour). London: Crosby Lockwood & Son, Ltd.

95. WILLIAMS, C. B. 1945. *The index of diversity as applied to ecological problems.* Nature, **155,** 390–391.

96. WILLIAMS, C. B. 1945. *Genetics in relation to diseases of animals and plants.* Nature, **155,**

97. WILLIAMS, C. B. 1945. *Evidence for the migration of Lepidoptera in South America.* Rev. d. Entom. Rio de Janeiro, **16,** 113–131.

98. WILLIAMS, C. B., and BEALL, G. 1945. *Geographical variation on the wing length of* Danaus plexippus. Proc. R. Ent. Soc. London, A **20,** 65–76.

99. WILLIAMS, C. B. 1945. *Recent light trap catches of Lepidoptera in the U.S.A. analysed in relation to the logarithmic series.* Ann. Ent. Soc. America, **38,** 357–364.

100. WILLIAMS, C. B. 1945. *Occurrence of* Vanessa cardui *at sea off the West African coast.* Proc. R. Ent. Soc. London, A **20,** 4–5.

101. WILLIAMS, C. B. 1945. *Notes on the fat content of two British migrant moths.* Proc. R. Ent. Soc. London, A **20,** 6–13.

102. WILLIAMS, C. B. 1946. *The migration of butterflies in South America.* In Livro de Homenagem a R.F. d'Almeida. Sao Paulo, Brazil, 333–349.

A summary of the known records of directional flights, or migration, on 25 species of South American butterflies, and two day-flying moths of the genus *Urania,* with a brief discussion and a bibliography of eight references.

103. WILLIAMS, C. B. 1946. *Yules' characteristic and the index of diversity.* Nature, **157,** 482.

A note pointing out that the "characteristic" proposed by Yule as a measure of the richness of a vocabulary becomes, in the logarithmic series, the reciprocal of the "index of diversity" proposed by Fisher and Williams.

104. WILLIAMS, C. B. 1946. *Fluctuation of insect populations as related to weather conditions.* Quart. J. Roy. Met. Soc., **71,** 222.

A brief statement of the importance of weather conditions in determining fluctuations of insect numbers, made at a symposium on "insects and weather" at a joint meeting of the R. Entomological and R. Meteorological Societies.

105. WILLIAMS, C. B. 1946. *Climate and insect life.* Nature, **157,** 214.

Comments on a joint discussion on "insects and weather" by the R. Entomological Society and the R. Meteorological Society with some attempts at forecasting insect numbers made by statistical methods from the results of four years trapping of insects at Rothamsted.

106. WILLIAMS, C. B. 1947. *A diagrammatic method of analysing the interrelation of the fauna or flora of several different localities.* Proc. Linnean Soc., **158,** 99-103.

A series of geometric figures when by the distribution of species in several localities (up to six) can be classified in to those found in one locality only, or in two- in three-, etc., localities.

107. WILLIAMS, C. B. 1947. *The logarithmic series and the comparison of island flora.* Proc. Linnean Soc., **158,** 104-110.

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By means of the logarithmic series it is possible to calculate the numbers of species common to two large samples of individuals taken from a single large population. The number of species of plants actually found to be common to two areas in such as islands, can be expressed as a proportion of the number that would have been common on the assumption of identity. This then becomes a statistical measure of their relationships. The method is illustrated from data obtained from Exells' "Vascular plants of Sao Tomé and the neighbouring West African Islands".

108. Evans, A. C. 1946. *Distribution of number of segments in earthworms and its significance.* Nature, **158,** 98.

Each species of worm has a characteristic number of segments, this is of value for identifying immature specimens. The departure of the distribution of the number of segments of adults from the normal distribution of the number for just hatched individuals can lead to interesting conclusions regarding the amount of predatism to which a species is subject, the presence or absence of regeneration in a species or genus, and finally whether an increase in the number of segments occurs during growth.

109. Evans, A. C. 1946. *A new species of earthworm of the genus* Allolobophora. Ann. Mag. Nat. Hist., Series **11, 13,** 98-101.

110. Cernosvitov, L. and Evans, A. C. 1947. *Lumbricidae. (Annelida). With a Key to the Commoner Species.* Synopses of the British Fauna, No. 6. 36 pp. London : The Linnean Society.

Department of Bee Research

111. Butler, C. G. 1946. *The provision of supplementary food to hive bees.* Ann. Appl. Biol., **33,** 307–309.

Four British Standard brood combs full of pollen provide the necessary protein requirements for a colony on B.S. equipment from late autumn until April of the following year.

Sucrose syrup is not so satisfactory as honey as winter and spring food for bees, but a mixture of equal parts of honey and syrup proves to be satisfactory. The strongest colonies in April are produced by confining feeding to autumn, and wintering the bees on 35–40 lb. of honey or honey and concentrated sucrose syrup. Feeding with syrup and pollen is only found to be advantageous when the colony concerned lacks adequate reserves of carbohydrate and protein; the feeding of honey or syrup in spring may have a retarding rather than a stimulative effect upon colony development.

112. Butler, C. G. 1946. *Further investigations on the value of electric heating of beehives.* Ann. Appl. Biol., **33,** 310–313.

Three groups of colonies of bees were employed, two of these groups having heat applied to them by means of a specially designed frame heater, different intensities of heat being applied in each case. No noticeable effect on the consumption of stores was observed and the heated colonies were weaker than the unheated colonies at the beginning of May. Colonies in top entrance hives wintered no better than those housed in normal bottom entrance hives, nor were significant differences in brood chamber temperatures recorded.

It is concluded that no benefit was obtained from electrical heating at the intensities of heat applied.

113. Butler, C. G. 1946. *Bee culture in the U.S.A.* Agriculture, **53,** 265–268.

A report on a tour of bee Research Centres and Agricultural Research Stations, etc., in the U.S.A.

114. Milne, P. S. 1947. *Sulphonamides and A.F.B.: Progress Report.* Agriculture (accepted for publication).

Experiments were conducted during 1946 in collaboration with County Beekeeping Instructors and Bee Disease Officers, at a number of centres on the control of American Foul Brood by feeding sulphonamides in sucrose syrup. Promising results were obtained in most instances and of the thirty-two colonies involved in these trials all but three were reported to be free from all visible signs of disease at the end of the season. Of the three cases in which satisfactory results were not obtained, two failed to respond to treatment and the third colony which was reported to be healthy following treatment showed a recurrence of the disease six weeks later. Further work will have to be done before a satisfactory opinion of the value of this treatment can be given.

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115. SYNGE, A. D. 1947. *Pollen collection by honeybees.* (Submitted for publication.)

Pollen collected daily from colonies of bees by means of pollen traps was analysed. Almost 50 per cent. of the pollen collected in Harpenden during the season was found to come from the clovers. A correlation between the number of loads of Red Clover pollen gathered by the bees and the daily maximum temperature was found, and this was shown to be due mainly to the increased number of red clover flowers opening at the higher temperatures. The floral mechanism making pollen available to the bee was investigated for a number of flowers including red and white clovers, *Vicia faba*, *Papaver rhoeas*, *Epilobium augustifolium*, and *Brassica alba*.

Large differences in the amounts of pollen gathered from different plant species were found between two neighbouring colonies in the same apiary.

Department of Insecticides

116. POTTER, C., and GILLHAM, E. M. 1946. *Effects of atmospheric environment, before and after treatment on the toxicity to insects of contact poisons.* I. Ann. Appl. Biol., **33,** 142–159.

Experiments were made on the effect of conditions before and after treatment on the toxicity to adult *Tribolium castaneum* Hbst. of the following contact poisons in the media stated: (1) pyrethrins, (2) lauryl thiocyanate, (3) nicotine—all in aqueous medium; (4) dinitro-o-cresol in ethylene glycol, (5) Wakefield half-white oil, (6) D.D.T. in Wakefield half-white oil.

The difference in environment before spraying did not have any marked effect, but, with the exceptions of nicotine and petroleum oil, all the toxicants used were more insecticidal when the beetles were kept under cool conditions after spraying. Nicotine showed little difference due to after-treatment when an inverted filter funnel was used to confine the insects, but seemed markedly more toxic under cooler conditions of after-treatment when the insects were confined in the dishes by means of muslin.

Wakefield half-white oil, a non-volatile petroleum oil, proved more toxic when the insects were kept under warm conditions after treatment than under cool conditions. The increase in toxicity of chemically active contact poisons under cool conditions of after-treatment appeared to occur whatever the nature of the carrier, whether volatile or non-volatile, water or oil.

In the substances tested, with the exception of nicotine under special circumstances, the increase in toxicity under cool conditions of after-treatment occurred whatever the volatility of the poison.

The change in toxicity, when cool conditions were compared with hot, varied with the poison used. With nicotine in aqueous medium the change was relatively small, the toxocity under cold conditions throughout being 1·23 times the toxicity under hot conditions throughout. At the other extreme with pyrethrins and terpineol in aqueous medium there was a large alteration, the toxicity under cold conditions throughout being about 7 times the toxicity under the hot conditions throughout.

117. POTTER, C., TATTERSFIELD, F., and GILLHAM, E. M. 1947. *A laboratory comparison of the toxicity as contact poison of D.D.T. with nicotine, derris products and pyrethrins.* Bull. Ent. Res., **37,** 469–496.

The toxicity of D.D.T. and nicotine as contact sprays under laboratory conditions have been tested on a number of insects. The particulars of the species are set out. Rotenone, derris resin and the pyrethrins were also tested on certain species. The results obtained are given in tables and in graphs.

118. TATTERSFIELD, F., POTTER, C., and GILLHAM, E. M. 1947. *The effect of medium on toxicity of D.D.T. to aphides.* Bull. Ent. Res., **37,** 497–502.

The data show that D.D.T. is 4–6 times as toxic to *Macrosiphum solanifolii* when applied in the emulsified form in a benzene cyclohexylamine sulphonated lorol medium as in the suspensoid form in a carbitol acetone sulphonated lorol T.A. medium.

119. MCINTOSH, A. H. 1947. *A dipping apparatus for estimating the toxicity of insecticides in liquid media.* Ann. Appl. Biol., **34,** 233-239.

An apparatus and technique are described for the study of the effect of liquid insecticidal preparations by dipping insects in the toxic material. The method is applicable to quick settling suspensions and quick creaming emulsions as well as to solutions. Dipping is performed at constant

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temperature with end-over-end shaking; the technique has the advantage over other dipping methods that have been described in that handling of individual insects whilst wet is eliminated.

120. HARPER, S. H., POTTER, C., and GILLHAM, E. M. 1947. *Annona species as insecticides.* Ann. Appl. Biol., **34,** 104–112.

By extraction and precipitation from several solvents the toxic principle present in *A. reticulata* and *squamosa* seeds and roots has been concentrated up to one hundred-fold. A preliminary chemical examination of this concentrate is described, leading to the conclusion that the toxicity is due to a glyceride or glycerides of a hydroxylated unsaturated acid or acids of high molecular weight.

These extracts have been examined for contact and stomach poison and ovicidal properties in a variety of media. As a contact insecticide against *Aphis fabae, Macrosiphoniella sanborni* and *Macrosiphum solanifolii* the toxicity of the concentrate was of the same order as that of rotenone, but was considerably less toxic to *Oryzaephilus surinamensis.* As a stomach poison the ether extract was both toxic and repellent to *Plutella maculipennis* larvae, but was neither toxic nor repellent to *Diataraxia oleracea* larvae. Ovicidal tests against the eggs of *P. maculipennis* and of *Ephestia kuhniella,* although showing some effect, were inconclusive. The potency of this concentrate is therefore of a limited nature and although of roughly the same order as that of rotenone to certain aphides, it has neither the intensity of effect nor the range of insecticidal action of that compound.

121. MARTIN, J. T., and BRIGHTWELL, S. T. 1946. *The determination of the pyrethrins in pyrethrum concentrates in mineral oil.* J. Soc. Chem. Ind., **65,** 379–382.

A method is described for the determination of Pyrethrin I in pyrethrum concentrates in light and heavy mineral oils. The method is based upon that of Wilcoxon as modified by Holaday and utilises the separation of chrysanthemum monocarboxylic acid and the reduction of Denigé's reagent. Modifications of the Wilcoxon-Holaday method, concerned with the initial removal of uncombined acids, the removal of the oil and the separation of the monocarboxylic acid, have been introduced. The determination of the monocarboxylic acid by the reduction of Denigé's reagent gives results for pyrethrin I slightly in excess of those given by a modified Seil method involving separation of the monocarboxylic acid by steam distillation. Pyrethrin II may be determined in oil solutions made from petroleum ether extracts of pyrethrum flowers by an application of the Seil method. Further work is required on the determination of pyrethrin II in oil solutions made from acetone extracts of the flowers.

122. LORD, K. A., and JOHNSON, C. G. 1947. *The production of dermatitis by pyrethrum and attempts to produce a non-irritant extract.* J. Dermatology & Syphilis, **59,** 367-375.

The production of dermatitis by continual application of a pyrethrum tragacanth anti-mosquito cream on a number of test subjects is described. It was established that the pyrethrum extract and not the "inert" base of the anti-mosquito cream was responsible for the reaction by application of these separately to subjects sensitized to the mosquito cream.

A number of extracts of pyrethrum flowers were prepared and subjected to chromatographic adsorption on columns of fuller's earth. After preliminary tests had been carried out on one sensitized subject the products were tested for irritancy on five test subjects previously sensitized to pyrethrum extracts.

The tests showed that the irritant factor could be largely removed from pyrethrum extracts in petroleum ether by a column of fuller's earth which preferentially retained the irritant substance. Similarly the factor was preferentially adsorbed from ethylene dichloride by fuller's earth, although the best preparation using this solvent was highly irritant compared with the best preparations using petroleum ether; it was, however, better in this respect than the least irritant commercial 40 per cent. pyrethrum extract available. Acetone extracts of the column of fuller's earth after percolation with pyrethrum extracts gave strong reactions on sensitized subjects. A considerable separation of pyrethrum I from pyrethrum II was obtained during the course of these preparations.

123. LORD, K. A., and BRAY, C. T. 1946. *The determination of the pyrethrin content of dilute preparations of pyrethrum flowers in oil.* J. Soc. Chem. Ind., **65,** 382–384.

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The Martin-Brightwell modification of the Wilcoxon-Holaday mercury reduction method, which was drawn up for the evaluation of pyrethrum preparations in mineral oil containing 6 per cent. of total pyrethrins, has been critically examined and modified to give accurate results for dilute preparations containing less than 0·2 per cent. total pyrethrins.

124. Bray, G. T., Harper, S. H., Lord, K. A., Major, F., and Tresadern, F. H. 1947. *The determination of the factor for pyrethrin I in the mercury method.* J. Soc. Chem. Ind. **66,** 275-279.

The authors have examined in two series of experiments the effect of varying the conditions under which the reduction of Denigé's reagent by chrysanthemum monocarboxylic acid is allowed to proceed. They have shown that both temperature and time of reaction influence appreciably the extent of the reduction; and have confirmed the result previously obtained by Graham and La Forge, that 1 ml. M/100 potassium iodate solution is equivalent to 5·7 mg. Pyrethrin I when the reduction takes place at 25±2° C. for 1 hour. Differences of 5 to 6 per cent. of the general mean value were shown in the second series despite careful standardisation of conditions.

Woburn Experimental Station

125. Mann, H. H., and Barnes, T. W. 1947. *The competition between barley and certain weeds under controlled conditions.* Part II. *Competition with* Holcus mollis. Ann. Appl. Biol., **34,** 252-266.

Holcus mollis is a twitch which has tended to overrun a good deal of land near Woburn on Lower Greensand soils. The vigour with which it grows is indicated by the fact that it produces about 2½ tons of dry rhizomes and roots per acre on land where it had grown for 10 months. All this rhizome growth occurred within the top 8 in. of the soil. It tends to increase till the roots occupy from 0·11 to 0·14 litres of space per 1 gm. of dried roots and rhizomes.

When barley and this weed are grown together the effect of the weed on the yield of barley depends on whether the barley gets a start on the weed or *vice versa*. If barley growth begins before that of *Holcus* it may be that the barley is able to smother the weed completely and the yield be unaffected, provided the barley is sown thickly enough. If the two competing plants start at the same time, thickness of planting is still able to limit the extent to which the weed can reduce the yield of barley, though even with the thickest planting the *Holcus* caused a reduction of one-third in the barley yield. Where *Holcus* is already established in the ground from the previous year, with a sparse barley crop, the weed is able to eliminate the barley completely, but where it is sown thickly it was still able to give a 50 per cent. yield.

126. Mann, H. H. 1946. *Wheat in the Middle East.* Emp. J. Exp. Agric., **14,** 31–42.

A description of the present status of wheat growing in the Middle East based on personal observations as well as on other available information.

127. Mann, H. H. 1946. *Millets in the Middle East.* Emp. J. Exp. Agric., **14,** 208–216.

A description of the various millets grown in the various countries of the Middle East, their present status and future possibilities, based on personal observations as well as on other available sources.

General

128. Ogg, W. G., and Nicol, Hugh. 1946. *Some Rothamsted contributions to agricultural chemistry.* Chemurgic Digest, **V,** 177.

129. Ogg, W. G. 1946. *The soil.* Royal Society Empire Scientific Conference.

130. Garner, H. V. 1946. *The management of farmyard manure.* Min. Agric., **53,** 299–305.

131. Garner, H. V. 1946. *The production of malting barley.* Min. Agric., **53,** 483–486.

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