ROTHAMSTED RESEARCH

Report for 1952

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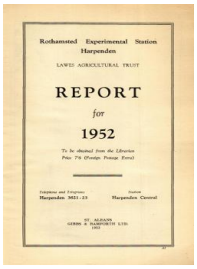

Publications / Abstracts of Papers

Rothamsted Research

Rothamsted Research (1953) *Publications / Abstracts of Papers ;* Report For 1952, pp 182 - 205 **-**
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PUBLICATIONS

Physics Department

1. SCHOFIELD, R. K. (1952). Control of grassland irrigation based on weather data. *Proc. 6th Int. Grassland Congr.* (In the press.)

An examination of the physics of evaporation and the available experimental data leads to the conclusion that the evaporation of water from any land area covered by green vegetation cannot exceed a well-defined maximum however liberally the vegetation is watered.

This maximum evaporation depends on the weather and particularly on the amount of incident solar radiation, since this is the main source of the latent heat of vaporization.

Under effective irrigation, evaporation remains at or near the maximum and can be computed from weather data. Such computations together with measurements of rainfall provide a basis for the control of irrigation. The estimation of maximum evaporation could be issued to farmers by a Meteorological Service as is already done in England.

There are many details concerning the frequency of irrigation and equipment best suited to soil, crop and market conditions that will long remain topics for discussion and investigation, but in most cases the *quantity* of water needed can be closely estimated from weather data.

2. PENMAN, H. L. (1952). Experiments on irrigation of sugar beet. *J. agric. Sci.* **42,** 286-292.

It is assumed that maximum growth requires maximum transpiration, and that maximum transpiration can be maintained by keeping the soil near to field capacity throughout the growing season. Transpiration rates can be calculated from weather data (the basic principles are outlined and an example of the calculation given), and the paper describes four field experiments in which attempts were made to control the water content of the soil throughout the growing season, by irrigation from overhead spray-lines.

In spite of differences in season and soil, the four sets of data are consistent in showing that maximum sugar yield is obtained when the soil-moisture deficit (amount of rain or irrigation needed to restore the soil to field capacity) does not exceed about 2 in. in mid-July, or about 4 in. in mid-September.

3. PENMAN, H. L. (1953). The physical bases of irrigation control. *Proc. 13th Int. Hort. Congr. London,* 1952. (In the press.)

Irrigation designed to replace transpiration losses can be controlled if transpiration rates can be adequately estimated. As a particular form of natural evaporation, transpiration is dominantly a weather-controlled phenomenon in which plant character plays only a minor part, and rates can be calculated from weather data. The physical principles, involving energy supply and turbulent transport of vapour, are outlined for open water, first because they are most clearly revealed for open water, and second because for south east England it has been possible to convert estimated open water evaporation into estimated transpiration by using an empirical conversion factor. By an extension of the principles and the introduction of stomatal and daylength factors, it has proved possible to eliminate local factors and to estimate transpiration rate directly from weather data without first calculating the rate for a hypothetical open water surface. The special case of orchard crops is separately treated.

Field checks, chiefly in the more extreme climate of southern Australia, have been satisfactory, but only by accepting somewhat arbitrary values of stomatal conductance for diffusive flow of water vapour. The checks are equally successful for short crops and for orchard crops.

4. PENMAN, H. L. (1952). Contribution to discussion on " Relation between daily rainfall and flow of the River Shin." *Proc. Instn civ. Engrs, Part III,* 45–48.

5. PENMAN, H. L. (1953). Contribution to symposium on " Hydrology." *J. Instn Wat. Engrs.* (In the press.)

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6. Long, I. F. (1951). Contribution to a symposium on " Electrical Meteorological Instruments." A recording anemometer. *J. Instn elect. Engrs*, **98**, 458.

A system of gears and cams converts the electrical impulses received from the anemometer (Mark III) into a continuous trace on a chart. Full scale deflection corresponds to a run-of-the-wind of fifty miles and the instrument then resets itself to zero.

Chemistry Department

7. Boyd, D. A., Cooke, G. W., Garner, H. V. & Moffatt, J. R. (1953). See No. 140.

8. Bremner, J. M. (1952). The nature of soil-nitrogen complexes. *J. Sci. Fd. Agric.* **3**, 497.

Results obtained at Rothamsted in recent work on soil-nitrogen complexes are discussed and information now available regarding the chemical nature of these complexes is reviewed. There is evidence that at least one-third, and some indication that as much as one-half, of soil nitrogen is in the form of protein. No method of separating this protein material from other soil constituents has been devised, but considerable information regarding its amino-acid composition is now available. There is evidence that some of the non-protein nitrogen of soil is in the form of nucleic acids and of amino sugars, but the chemical nature of much of this nitrogen remains obscure.

9. Cooke, G. W. (1952). Recent developments in fertilizer practice. *Bull. Docum. Ass. int. Fabr. Superph.* Paris, **12**, 20.

A summary in French and English of results of recent field experiments.

10. Cooke, G. W. (1952). Försök i England rörande sådd av handelsgödselmedel. *Växt-närings-Nytt.* **8**, 28.

A summary in Swedish of results of recent field experiments on fertilizer placement.

11. Crowther, E. M. & (Walker, T. W.) (1952). The relative values of alternative liming materials. *Agriculture, Lond.*, **59**, 251.

The results of a number of field experiments carried out by advisory soil chemists from 1944 to 1948 are summarised. In most of the experiments the standard rate of application was determined by the Hutchinson-McLennan " lime-requirement method." Burnt lime was tested at half and full standard rate and the other materials generally at the standard rate. On the average, the standard rates doubled the crop yields, but applications at half this rate increased yields by about 85 per cent. Little is to be gained therefore under normal conditions from liming at higher rates than are indicated by laboratory tests, and it will often prove more economic to use even smaller dressings and to repeat them after a few years when further tests show this to be advisable. Ground limestones, ground to give about 40 per cent through the 100 mesh sieve, were fully as effective as equivalent amounts of burnt lime, presumably because they can be spread and incorporated into the soil more evenly than burnt limes. Magnesian limes and limestones had some advantage over high-calcium materials in a few experiments on recently reclaimed light land, and gave similar results on more normal soils.

12 Crowther, E. M. (1952). American fertiliser practice and problems. *Fertiliser Soc. Trans.* (*Proc. No.* 17).

This paper summarises American research on soil fertility and fertilizer problems, as seen during an eleven-week tour with the assistance of the Economic Co-operation Administration. An attempt was made to assess the relevance for British conditions of a number of recent American developments in the production and use of fertilizers and to understand the geographical, historical and technical reasons for the differences in practice between roughly comparable parts of the two countries. Special attention was given to the use of ammonium nitrate as such, the injection of anhydrous ammonia, the ammoniation of mixed fertilizers, the production of phosphorus fertilizers by high-temperature processes, the use of ground phosphate rock in Illinois and adjoining States but not elsewhere, the ammonium citrate

test for " available phosphoric acid " in fertilizers, the methods adopted for fertilizer control and for compiling statistics for local fertilizer consumption, methods of fertilizer placement, the use of rapid soil tests for advisory work on manuring, recent work on radio-phosphorus.

13 CROWTHER, E. M. (1953). The sceptical soil chemist. *J. Soil. Sci.* **4**, 107.

In a presidential address to the British Society of Soil Science, delivered at the Summer Meeting held at the Royal Agricultural College, Cirencester, an attempt was made to review some aspects of the tactics and strategy in soil research. Quotations from Plato on denudation and soil erosion and from Robert Boyle and John Evelyn on investigating problems of crop nutrition and manuring by surveys and experiments were used to show how far brilliant pioneers could go in interpretive descriptions and in formulating research projects. The early promise was checked by the lack of appropriate techniques and special funds for making reliable agricultural experiments and surveys, as well as by the inadequacy of the more basic sciences. Somewhat similar conditions still remain, especially in under-developed areas, and it is important to ensure that field experiments and soil surveys keep pace with laboratory investigation on soils.

Some American attempts to build up comprehensive systems for treating all kinds of soil in a manifold classification based on a set of differentiating characteristics are criticised. An alternative treatment might be to recognize the practical value of many alternative and overlapping groups of similar or geographically associated kinds of soil and then to endeavour to relate each of these groups to their environmental conditions, using rigid statistical methods, whenever possible. If the problem of correlating internal and external characteristics of the units of landscape having similar soils were regarded as an attempt to fit the distributions of related soils into a hyper-space model of environmental and historical conditions, some of the past controversies about certain higher categories in soil classification would be seen to represent projections on to different planes in the model. It would also be clear that where a single kind of soil occurs in regions differing markedly in one soil-forming factor, there must of necessity be concomitant variations in some other compensating factor. The analogy with a hyper-space model and the systematic search for relationships between soil and environmental conditions may prove more profitable than attempts to devise complete formal schemes for soil classification based on groupings by single factors.

14 CROWTHER, E. M. (REYNOLDS, J. R. & SHORROCK, R. W.) (1952). Experiments on the manuring of peas. *Agriculture, Lond.* **58**, 584.

N, P and K fertilizers broadcast in preparing seedbeds for threshed peas gave only small responses on the average of a number of field experiments on commercial farms. The only consistent result was a gain from potassium fertilizers on soils found by soil analysis to be deficient in this element. Another series of experiments by G. W. Cooke, reviewed in the Rothamsted Report for 1951 (p. 37), also showed low responses from broadcasting PK fertilizers for peas, but much better results were obtained by placing the fertilizer in a band to the side of and below the seed.

15. CROWTHER, E. M. & BENZIAN, B. Committee on nutrition problems in forest nurseries. Summary Report on 1950 experiments. *For. Comm. Rept. on For. Res.* 1950-51, 113.

Annual report on investigations reviewed in the Rothamsted Report for 1950, 41–43.

Pedology Department

16 BLOOMFIELD, C. (1952). The distribution of iron and aluminium oxides in gley soils. *J. Soil Sci.*, **3**, 167.

An account of an investigation of the distribution of ferric and aluminium oxides in two gley soils from Lancashire of different types. In a mottled gley soil, it was found that the distribution of free aluminium oxide was the same as that of the ferric oxide, i.e. the aluminium was concentrated in the iron-stained zones. Despite differences in the intensity of gleying, the free iron of the grey (bleached) soil was constant. For an unmottled gley soil

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under peat, the results indicated removal of the sesquioxides in a vertical direction.

17 BROWN, G. & GREENE-KELLY, R. (1952). Diffraction by randomly inter-stratified layers in a clay mineral. *Brit. J. appl. Phys.*, **3**, 281.

The Hendricks-Teller theory of diffraction by randomly interstratified minerals has been applied to the Li-montmorillonite-glycerol system and agreement between calculated and observed results is good.

18 BROWN, G. & NORRISH, K. (1952). Hydrous micas. *Miner. Mag.*, **24**, 929-932.

Calculation of structural formulae of hydrous micas based on the assumptions that the excess of water is present as interlayer oxonium ions replacing potassium of the ideal mica give structural formulae which are in good agreement with the formulae of ideal micas.

19 BROWN, G. NORRISH, K. & GREENE-KELLY, R. (1952). Organic derivatives of montmorillonite. *Clay Min. Bull.*, **1**, 214-220.

Chemical and X-ray diffraction studies of alleged organic derivatives of montmorillonite failed to confirm their existence.

20. BUTLER, J. R. & LE RICHE, H. H. (1951). *Spectrochim. Acta*, **4**, 435-438.

A spectrographic modification of the internal standard method.

21. GREENE-KELLY, R. (1952). Organic derivatives of montmorillonite. *Nature, Lond.*, **169**, 756.

(1952). Organic derivatives of montmorillonite. *Clay Min. Bull.*, **1**, 214.

In conjunction with G. Brown and K. Norrish the evidence in favour of the formation of covalent bonded groups to montmorillonite is critically examined. As a result of the study of derivatives prepared by Deuel and by the authors, they concluded that covalent bonded groups are not formed.

22. GREENE-KELLY, R. (1952). Irreversible dehydration in montmorillonite. *Clay Min. Bull.*, **1**, 221.

The occurrence of irreversible collapse of the sheets of montmorillonite on moderate heating is found to depend in the nature of the interlayer ion. In particular the lithium ion is found to be very effective. This result is discussed in terms of the Mering hypothesis that irreversible collapse is accompanied by loss of structural water. It is concluded that this hypothesis is not likely to hold for this type of irreversible behaviour.

23. GREENE-KELLY, R. (1952). A test for montmorillonite. *Nature, Lond.*, **170**, 1130.

24. BRINDLEY, G. W. & MACEWAN, D. M. C. (1952). Structural aspects of the mineralogy of clays and related silicates. *J. Brit. Cer. Soc.*, Anniversary Volume. (In the press.)

A detailed account of the structural features of layer silicates, and an attempt to correlate them with chemical composition, morphology and cation exchange properties.

25. MACEWAN, D. M. C. (1953). Randomly stacked layers in clay minerals. *Nature, Lond.* **171**, 616.

If the X-ray diffraction from the basal planes can be separated from the rest of the diffraction given by a clay mineral, then the cosine transform of $i=\left\{ I(\mu)\Big/\Theta\,|F_l|^2 \right\}1$ (the notation being as in James, *Optical Principles of the Diffraction of X-rays* and F_1 being the scattering factor of a *layer*) gives the number of layers at an arbitrary distance from any given layer, on the assumption that only one type of mineral layer is present, and that the interlamellar material (commonly water) has a low scattering power for X-rays. This function is difficult to calculate in practice, and it is shown that the related function

$$\Sigma_l \frac{I_r}{\Theta|F_l|^2} \cos 2\pi\mu_r R$$

where I_γ is the integrated intensity of an X-ray line and μ_γ its reciprocal spacing, very often gives essentially the same information. This function is readily calculable.

26. MacEwan, D. M. C. (1952). The First National Conference on Clays and Clay Technology at Berkeley, California. *Claycraft.* **26**, 204
An account.

27. Stephen, I. (1952). A study of rock weathering with reference to the soils of the Malvern Hills. Part I. Weathering of biotite and granite. *J. Soil Sci.*, **3**, 20.

28. Stephen, I. (1952). A study of rock weathering with reference to the soils of the Malvern Hills. Part II. Weathering of appinite and 'Ive-Scar rock.' *J. Soil Sci.*, **3**, 219.
A study of four residual soils derived from different members of the Malvern crystalline-complex has shown the importance of the parent bedrock in determining their mineralogical composition. The coarser material in the soils consists mainly of the relatively unweathered minerals characteristic of the underlying rock, whilst the composition of the colloidal material reflects the trend of alteration of the primary minerals on weathering. The colloids of the soils derived from the untrabasic biotite- and hornblende-rich rocks consist mainly of chlorite-vermiculite. The progressive change from chlorite in the weathered rock to mixed chlorite-vermiculite and vermiculite in the soil has been traced. It is suggested that the mechanism of the change may be successive exchange of $2H^+$ for Mg^{2+} leading to conversion of OH^- into H_2O and results finally in the disintegration of the brucite layer leading to esparate exchangeable ions as in vermiculite. With increase in the feldspar content of the bedrock (diorite), illite in addition becomes prominent in the soil colloids, and is dominant in those derived from granite.

Soil Microbiology Department

29. Meiklejohn, J. (1953). Iron and the nitrifying bacteria. *J. gen. Microbiol.* (In the press.)
The oxidation of ammonia to nitrite in enrichment cultures of *Nitrosomonas spp.* was hastened by 6 mg. Fe/l in the medium. Manganese did not replace iron as a stimulant; it was toxic. *Nitrosomonas europaea* (Jensen's strain) and a strain of *Nitrobacter winogradskii*, had in pure culture, very small absolute requirements for iron; they oxidised ammonia and nitrite respectively in media purified with 8-hydroxyquinoline, and with no iron added. Small amounts of iron hastened the oxidation of ammonia and nitrite; the minimum concentration giving this stimulating effect was 0·1 mg. Fe/l for the strain of *Nitrosomonas europaea* and 0·3 mg. Fe/l for the strain of *Nitrobacter winogradskii*. The optimum amount of iron for oxidation appeared to be about 6 mg./l for both species. Both species tolerated 112mg. Fe/l (about 0·002 M), but oxidation was delayed, markedly in the case of *Nitrobacter winogradskii*, by 560 mg./l (about 0·01 M).

30. Meiklejohn, J. (1953). Some organic substances and the nitrifying bacteria. *Proc. Soc. appl. Bact.* (In the press.)
1. The rate of nitrification in mixed cultures is not affected by the simultaneous decomposition of cellulose.
2. No stimulation of the rate of nitrification was observed in cultures containing: culture filtrates, soil extract, thiamin, yeast extract, urine, or *beta*-indoleacetic acid. These substances either had no effect, or in larger doses, delayed or stopped nitrification.
3. Peptone is toxic to the nitrifying bacteria.
4. Potassium chlorate does not affect the oxidation of ammonia to nitrite, but it stops the oxidation of nitrite to nitrate in cultures, as it does in soil.
5. M/25 sodium fluoride stops the oxidation of ammonia to nitrite.

31. Meiklejohn, J. (1952). Minimum phosphate and magnesium requirements of nitrifying bacteria. *Nature, Lond.* (In the
A strain of *Nitrosomonas europaea* survived eleven successive transfers on to medium with phosphate omitted. A strain of *Nitrobacter winogradskii*

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ceased to oxidise nitrite to nitrate in the second transfer o phosphate-deficient medium but the bacteria survived. Both species continued to oxidise ammonia or nitrite respectively up to the fourth successive transfer on to medium with magnesium omitted.

32. MEIKLEJOHN, J. (1953). The nitrifying bacteria: A review. *J. Soil Sci.* (In the press.)

33. MOLLISON, J. E. (1953). Effect of partial sterilization and acidification of soil on the fungal population. *Trans. Brit. mycol. Soc.* (In the press.)

The effects on the soil fungal population of steam, formalin and acid treatments applied to an old forest nursery soil over Lower Greensand at Ampthill, Bedfordshire are reported. Samples of soil from the different plots were taken at intervals up to 25 months after treatment and the numbers of fungi per gram of soil estimated by plating dilutions. Steaming reduced the total numbers of fungi throughout the period tested. The fungi re-colonizing steamed plots were varied. Formalin also reduced numbers but the recolonizing species were dominated by *Trichoderma*. The numbers of fungi increased slightly after acid treatment.

34. NUTMAN, P. S. (1953). Studies on the physiology of nodulation formation. IV. The mutual inhibitory effects on nodule production of plants grown in association. *Ann. Bot. N.S.* (In the press.)

The number of root nodules formed on a clover plant in test tube culture on agar varies directly with volume of medium and inversely with number of plants present. The inhibitory activities of the following selected lines of clover are compared: effective in N-fixation and ineffective, sparsely and abundantly nodulating, resistant to infection by *Rhizobium* and normally susceptible, and plants which nodulate early or late in seedling growth. Early lines of plant inhibit nodulation more strongly than late lines but no differences show in the inhibiting activities of any of the other categories of plant, in spite of large differences in plant size. Successive replanting of agar cultures also leads to inhibition. Non-leguminous companion plants (lettuce and flax) are less inhibitory for clover nodulation than a second clover plant.

Nodulation of lucerne and vetch are similarly affected by the presence of a companion plant of the same species but among heterogeneous associations of different species, inhibition is not invariable. Inhibition is not related to the numbers of bacteria of either of the strains present or to the pH of the medium. The hypothesis is advanced that inhibition may be due to the secretion of specific inhibitory substances from the root.

35. SINGH, B. N. (1952). Nuclear division in nine species of small free-living amoebae and its bearing on the classification of the order Amoebida. *Phil. Trans. B.*, **236,** 405-461.

A study of nine species of small free-living amoebae has been made under standardized and reproducible cultural conditions, by a new method than enables specimens in all stages of division to be obtained easily. In all species the resting nucleus shows a Feulgen-negative nucleolus and Feulgen-positive chromatin granules. Nuclear division in these species and in other amoebae described by other workers is of two main types on which it is proposed to create two new families—Schizopyrenidae and Hartmannellidae. In Schizopyrenidae, the type genus Schizopyrenus n.g. and two other genera, Naegleria and Didascalus n.g., are defined. *Naegleria gruberi, Didascalus thorntoni* n.sp., *Schizopyrenus russelli* n.sp., *S. erythaenusa* n.sp. and *S. atupus* n.sp. are described. In Hartmannellidae the type genus Hartmannella is defined. *H. glebae, H. rhysodes* n.sp., *H. leptocnemus* n.sp. and *H. agricola* are described. The relation of the proposed classification to previously defined families and general of amoebae, and its bearing on phylogeny are discussed.

36. SINGH, B. N. (1953). The effect of partial sterilization by steam and formalin on the numbers of amoebae in field soil. *J. gen. Microbiol.* (In the press.)

In Sitka spruce nursery plots the numbers of amoebae in steam treated soil rose with the increase in the bacterial population. The population of

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amoebae over a period of seven months was much higher in this soil than in the untreated or the formalin-treated soils. The formalin-treated soil had significantly lower numbers of amoebae compared with the untreated soil over a period of one year, although the bacterial numbers were often higher in the former than in the latter. it is suggested that the unsuitable quality of bacterial food supply might be responsible for keeping the numbers of amoebae in check in the foramlin-treated soil. Double formalin treatment seemed to suppress further the numbers of amoebae.

37. THORNTON, H. G. (1952). The symbiosis between *Rhizobium* and leguminous plants and the influence on this of the bacterial strain. *Proc. roy. Soc. B.*, **139,** 170.

38. NUTMAN, P. S. (1952). Host factors influencing infection and nodule development in leguminous plants. *Proc. Roy. Soc. B.* **139,** 176.

These two papers formed part of a Symposium held at the Royal Society and were reviews of recent work on the symbiosis between *Rhizobium* and its host legume.

39. WALKER, N. & WILTSHIRE, G. H. (1953). The breakdown of naphthalene by a soil bacterium. *J. gen. Microbiol.*, **8.** (In the press.)

A bacterium isolated from soil can be grown with naphthalene as sole carbon source and produces *D-trans*-1:2-dihydro-1:2-dihydroxynaphthalene and salicylic acid.

40. WALKER, N. & (EVANS, W. C.) (1952). Pathways in the metabolism of the mono-hydroxybenzoic acids by soil bacteria. *Biochem. J.*, **52.** (In the press.)

Several strains of *Ps. fluorescens* have been found to grow in a mineral salt medium and using either salicylic acid or *m*-hydroxybenzoic acid as the sole carbon source. Salicylate grown cells are adapted simultaneously to catechol and *cis-cis*-muconic acid but not to phenol or any of the possible dihydroxybenzoic acids.

Cells grown on *m*-hydroxybenzoic acid are simultaneously adapted to gentistic acid. Thus, salicylic acid is metabolised through catechol and *m*-hydroxybenzoic acid via gentisic acid.

Botany Department

41. WATSON, D. J. (1952). The physiological basis of variation in yield. *Advanc. Agron.*, **4,** 101.

A review of work on the physiological analysis of plant growth and yield, with special reference to the nature and causes of variation in net assimilation rate and leaf area of field crops.

42. WATSON, D. J. & WATSON, M. A. (1953). Comparative physiological studies on the growth of field crops III. The effect of infection with beet yellows and beet mosaic viruses on the growth and yield of the sugar beet root crop. *Ann. appl. Biol.* **40,**1.

Infection with beet yellows virus depressed the dry matter yield of sugar beet plants by decreasing both net assimilation rate (NAR) and leaf area. It did not reduce leaf number.

Plants infected at the end of June had 30-50 per cent of their leaf area yellowed from mid-August. Later infection caused less yellowing. The yellowing almost sufficed to account for the decrease in NAR, if yellowed parts of leaves do not photosynthesise. However, there is evidence that the rate of photosynthesis may not be much slowed by infection; if so the decrease in NAR indicates a large increase in respiration rate.

The effects of yellows-infection on leaf area and NAR were independent, e.g. late-sown plants suffered a greater reduction of leaf area but a smaller reduction of NAR than early-sown plants.

Most of the loss of dry matter was in the root; the dry weight of petioles (including stem tissue) was also decreased, but the dry weight of leaf lamina was little affected.

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Yellows-infection increased the carbohydrate content, especially reducing sugars, and decreased the water and nitrogen contents of the leaf lamina. It increased the nitrogen content of petiole and root but did not change their water content. It reduced the sugar content of the root, but the loss of sugar yield was mainly attributable to decreased root weight.

Infection with beet mosaic virus caused a smaller loss of yield than yellows-infection; the dry weights of all parts of the plant were decreased. Mosaic-infection reduced both NAR and leaf area. It had no effect on carbohydrate content or water content of the leaf lamina, or on the water content of petiole and root. It increased the nitrogen content of all parts of plants that received no nitrogenous fertilizer, but not of nitrogen-treated plants. It slightly increased the sugar content of the root.

Biochemistry Department

General Papers

43. Mann, P. J. G. (1951). Review of work on manganese oxidation in higher plants. *Rep. Rothamsted exp. Sta.*, **1951,** 168.

44. Pirie, N. W. (1952). Agriculture : The universal provider. *Chem. Ind.*, 473.

45. Pirie, N. W. (1952). On Scientific reviewing and writing. *Science*, **116,** 401.

46. Pirie, N. W. (1952). The biochemistry of conception control. *Eugen. Rev.*, **44,** 129.

47. Pirie, N. W. (1952). The effects of size and stability on antigenicity. *Symp. biochem. Soc.*, **10,** 81.

48. Pirie, N. W. (1952). Geochemical aspects of the origin of complex molecules on the earth, as precursors to organic life. (by V. M. Goldschmidt. Edited by N.W.P.). *New Biol.*, **12,** 97.

48a. Pirie, N. W. (1952). Vital blarney. (Review of *The physical basis of life* by J. D. Bernal). *New Biol.*, **12,** 106.

49. *See* 64.

50. Tracey, M. V. (1953). Principles of biochemistry: a biological approach. London : Isaac Pitman. (In the press.)

Research Papers

51. (Boyland, E., Manson, D., Solomon, J. B.) & Wiltshire, G. H. (1953). The occurrence of *m*-hydroxybenzoic acid in urine. *Biochem. J.*, **53,** 420.

3-hydroxybenzoic acid was isolated from the urine of rats and rabbits fed on a normal diet and was increased by dosing with naphthalene.

52. (Boyland, E.) & Wiltshire, G. H. (1953). Metabolism of naphthalene by liver slices. *Biochem. J.*, **53,** 424.

Naphthalene was oxidised to 1:2-dihydro-1:2dihydroxynaphthalene by liver slices from rats and rabbits.

53. Holden, M. & Pirie, N. W. (1952). The behaviour of nucleic acids in tobacco leaf. *Proc. Second Int. Congr. Biochem.*, 259.

54. Kenten, R. H. & Mann, P. J. G. (1952). Hydrogen peroxide formation in oxidations catalysed by plant a-hydroxyacid oxidase. *Biochem. J.*, **52,** 130.

1. Hydrogen peroxide is produced during the oxidation of lactate, glycollate and glyoxylate catalysed by plant α-hydroxyacid oxidase. This has been shown by the effect of catalase on the oxygen uptake.

2. The oxidation products depend on the amount of catalase present. In the absence of catalase the enzyme-catalysed reactions are followed by non-enzymic reactions between the hydrogen peroxide and pyruvate or glyoxylate, with the formation of acetate or formate respectively.

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3. It is suggested that oxalate is the product of the enzyme-catalysed oxidation of glyoxylate.

55. KENTEN, R. H. & MANN, P. J. G. (1952). The oxidation of manganese by enzyme systems. *Biochem. J.*, **52,** 125.

1. The oxidation of bivalent manganese (Mn++) can be brought about by enzyme systems producing hydrogen peroxide such as D-amino-acid oxidase, xanthine oxidase and plant amine oxidase systems coupled with peroxidase systems.

2. With high Mn++ concentrations the oxidation was demonstrated by the increased oxygen uptake and by the estimation of manganese oxidation product with hydrazine. The oxidation product accumulates in both pyrophosphate and orthophosphate media.

3. With low Mn++ concentrations the oxidation was demonstrated by the increased oxygen uptake of the system in the presence of oxalic acid. Under these conditions the manganese is involved in a cycle of oxidation and reduction.

4. The oxidation of Mn++ by peroxidase systems can be used as a test for hydrogen peroxide. By this test it has been shown that plant α-hydroxy-acid oxidase produces hydrogen peroxide while catalysing the oxidation of L-lactic and glycollic acids.

56. PIRIE, N. W. (1952). Protein production from green leaves. *World Crops*, **4,** 374.

A brief description of the equipment used to extract protein from field crops on a large scale and some information about efficiency of extraction and the quality of the product.

57. SMITHIES, W. R. (1953). Determination of glucosamine in the presence of interfering substances. *Biochem. J.* (In the press.)

Glucosamine on acetylation with acetic anhydride and anhydrous sodium acetate forms N-acetyl glucosamine in quantitative yield. This may be determined by the Morgan and Elson method without interference from amino acids and sugars.

58. TRACEY, M. V. (1952). Chitinase and cellulase of nematodes. *Proc. Second Int. Congr. Biochem.*, 242.

59. TRACEY, M. V. (1952). The determination of glucosamine by alkaline decomposition. *Biochem. J.*, **52,** 265.

1. A method for the estimation of amino sugars in the range 50-500μg., by alkaline decomposition and estimation of the ammonia produced, is described.

2. Elimination of interference by other nitrogen containing compounds is discussed.

Plant Pathology Department

GENERAL PAPERS

60. BAWDEN, F. C. (1952). Reducing losses from virus diseases. *Gdng. ill.*

61. BAWDEN, F. C. (1953). Criticism of binomial nomenclature as applied to plant viruses. In *Virus and Rickettsiae Classification and Nomenclature. Ann. N.Y. Acad. Sci.* **56,** 538.

62. BAWDEN, F. C. (1952). The control of plant diseases. *Listener,* **48,** 294.

63. BAWDEN, F. C. (1953). Controlling plant diseases. *Agriculture, Lond.,* **59,** 451.

64. BAWDEN, F. C. & PIRIE, N. W. (1953). Virus multiplication considered as a form of protein synthesis. (In: *Multiplication of Viruses.* Oxford University Press. p. 21.)

65. BROADBENT, L. (1952). Transmission of potato viruses by aphids and spread in the field. *Proc. Conf. Potato Virus Diseases, Wageningen-Lisse,* 9.

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66. BROADBENT, L. (1952). The control of potato virus diseases by application of insecticides. *Proc. Conf. Potato Virus Diseases, Wageningen-Lisse*, 23.

67. BROADBENT, L. (1952). The control of potato virus diseases by roguing and early harvesting. *Proc. Conf. Potato Virus Diseases, Wageningen-Lisse*, 34.

68. BROADBENT, L. (1952). Barrier crops may help to reduce cauliflower mosaic. *Grower*, **38**, 1140.

69. GLYNNE, M. D. (1952). Observations on chocolate spot. *In:* The Rothamsted experiments on field beans, Part 2. *J. R. agric. Soc.* (In the press.) **113**, 70.

70. GREGORY, P. H. (1952). The sycamore sooty bark fungus (*Cryptostroma corticale*). *Essex Nat.*, **29**, 13.

71. GREGORY, P. H. (1952). Presidential Address. Fungus spores. *Trans. Brit. mycol. Soc.*, **35**, 1.

72. HULL, R. (1952). Can Virus Yellows be avoided in 1952 ? *Brit. Fmr.*, No. 44, Feb. 29.

73. HULL, R. (1952). The Virus Yellows war is not yet won. *Brit. Sug. Beet Rev.*, **21**, 29.

74. HULL, R. The control of Virus Yellows in sugar beet seed crops. *J. R. agric. Soc.* **113**, 86.

75. KASSANIS, B. (1951). The control of plant viruses by therapeutic methods. *Proc. Conf. Potato Virus Diseases, Wageningen-Lisse*, 13.

RESEARCH PAPERS

76. BAWDEN, F. C. & (FREEMAN, G. G.) (1952).The nature and behaviour of inhibitors of plant viruses produced by *Trichothecium roseum* Link. *J. gen. Microbiol.*, **7**, 154.

Culture filtrates of *Trichothecium roseum* contain two heat-stable substances that inhibit infection with plant viruses. One is trichothecin, an anti-fungal substance with the molecular formula $C_{19}H_{24}O_5$; it sometimes visibly damages bean leaves. The other was isolated as a polysaccharide, $[\alpha]_D^{19°} = -33°$; it contains 1·1-1·4% nitrogen, yields 60-70% reducing sugars (as glucose) on acidic hydrolysis, and the predominant (45%) component sugar is D-galactose. The polysaccharide does not combine with tobacco mosaic virus *in vitro*.

The extent to which infection is inhibited depends on the species of the host plant but not on the identity of the virus. Trichothecin, like ribonuclease, is relatively more effective with beans than with *Nicotiana glutinosa*, whereas the polysaccharide and two derivatives of trichothecin (trichothecolone and acetyl-trichothecolone) affect *N. glutinosa* more than beans. Trichothecin inhibits infection when sprayed over leaves a day after they have been inoculated with viruses, but is ineffective when applied 2 days before. The polysaccharide inhibits when sprayed over leaves before inoculation but not after. It is suggested that inhibitors act by temporarily altering the metabolism of leaf cells so that introduced virus particles cannot multiply and are inactivated.

77. BAWDEN, F. C. & KLECZKOWSKI, A. (1953). The behaviour of some plant viruses after exposure to ultraviolet radiation. *J. gen. Microbiol.*, **8**, 145.

Preparations of tobacco mosaic virus (TMV) inactivated by ultraviolet radiation interfered slightly with infection by active tomato bushy stunt (BSV) and Rothamsted tobacco necrosis (RTNV) viruses, and much more so with active TMV. Similarly, inactivated RTNV interfered slightly with infection by TMV and more so with active RTNV. In contrast, inactivated BSV did not affect the numbers of lesions produced by active virus preparations.

The residual infectivity of irradiated preparations of RTNV and BSV was greater when inoculated plants were exposed to light than when they were kept in the dark. This occurs because of some light-sensitive mechanism in the host cells and exposing the irradiated virus preparations to visible light did not affect their infectivity. Irradiated preparations of TMV had the same residual infectivity whether plants were placed in the light or dark after inoculation.

Although the three viruses have particles of different sizes and shapes, the course of inactivation by ultraviolet with each approximated closely to that of a first order reaction.

78. BROADBENT, L., GREGORY, P. H. & TINSLEY, T. W. (1952). The influence of planting date and manuring on the incidence of virus diseases in potato crops. *Ann. appl. Biol.*, **39**, 509.

Field experiments with Majestic potatoes were made over six years at Rothamsted to test the effects of varying date of planting and manuring on the yield of tubers and the incidence of the aphid-transmitted leaf roll and Y (rugose mosaic) viruses. Yield was increased by early planting, and by all the manures, especially dung. Early planting also usually increased the incidence of virus diseases. Different manures had different effects on disease incidence; the average results from all comparisons showed the largest increase in incidence of both viruses from the use of dung; sulphate of ammonia increased the incidence of leaf roll, and muriate of potash that of rugose mosaic. Counts in two years showed that aphid populations were highest on the earlier planted potatoes, and were increased by dung, sulphate of ammonia and superphosphate, but were reduced by muriate of potash.

79. GLYNNE, M. D. (1953). Production of spores by *Cercosporella herpotrichoides*. *Trans. Brit. mycol. Soc.*, **36**, 46.

Eyespot lesions on young wheat plants in the field regularly produced conidia of *Cercosporella herpotrichoides* Fron. in early spring. Conidia were not produced on mature growing plants, but, after ploughing, lesions on infected straws spored freely, especially in wet weather.

In the laboratory, eyespot lesions on straws produced spores when soaked in water for 24 hours, drained and kept continuously wet. Five mm. discs, cut from cultures on potato dextrose or water agar, produced spores abundantly when kept touching water at favourable temperatures, but excess water reduced sporing. Spores developed most abundantly when temperatures fluctuated between −3 and 13° C, were produced freely when temperatures fluctuated between 12 and 22°C, more slowly at 1–2°C and were not produced at 24–25°C. Daylight did not seem to influence spore production.

80. GREGORY, P. H. & HIRST, J. M. (1952). Possible role of basidiospores as air-borne allergens. *Nature, Lond.*, **170**, 414.

Routine observations with the automatic volumetric suction trap in the open air at Rothamsted revealed the occurrence of transient clouds of hyaline basidiospores. The numbers of coloured basidiospores were reasonably uniform between mid-August and mid-September and seldom fell below 1,000 per cubic metre. It is suggested that these concentrations of basidiospores may have significance as respiratory allergens. Older trapping methods had failed to reveal the basidiospore content of the air.

81. GREGORY, P. H. (1952). Spore content of the atmosphere near the ground. *Nature, Lond.*, **170**, 475.

Knowledge of the composition and variation of the air ' spora ' is important in agriculture and in medicine. Methods in current use have various defects, particularly in failing to catch the smaller spores at all and giving a logarithmic bias in favour of the larger types. The Cascade Impactor has been used in sampling the outdoor air ' spora ' at Rothamsted during a number of 24-hour periods, and the spores in the four size fractions obtained with this trap at different times of day and night are described. Some components of the air ' spora ' cannot yet be classified even to a major group of organisms. The Cascade Impactor allows a preliminary visual examination of the entire air ' spora ', and in comparative tests it was found that the Hirst automatic volumetric suction trap was, in practice, equally efficient.

82. HULL, R. & GATES, L. F. (1953). Experiments on the control of beet yellows virus in sugar beet seed crops by insecticidal sprays. *Ann. appl. Biol.*, **40**, 60.

Field experiments made in eastern England between 1943 and 1951 showed that *Myzus persicae* lived on stecklings throughout some winters and that most of the yellows in transplanted seed crops were plants that became infected in the steckling bed. A larger proportion of stecklings sown at the end of July or early August became infected than of those sown about a month later. The incidence of yellows was reduced by spraying stecklings with nicotine in late autumn after aphids had ceased migrating. A greater reduction was obtained with persistent and systemic organo-phosphorus insecticides; in one experiment three applications of E.605 reduced incidence to one-ninth that in unsprayed plots. However, in years when stecklings were exposed to very many incoming aphids, plots sprayed three times had 78 per cent of the plants with yellows. Although spraying often greatly reduces the incidence of yellows, it is unlikely to give adequate control in years and districts in which many viruliferous aphids move in the autumn. Spraying in September and October is usually more effective than in August.

83. KASSANIS, B. (1952). Some effects of high temperature on the susceptibility of plants to infection with viruses. *Ann. appl. Biol.*, **39**, 358.

When plants were kept at 36° C for some time before inoculation, their susceptibility to infection by five mechanically transmissible viruses was greatly increased. When kept at 36° after inoculation, fewer local lesions were produced than at lower temperatures, but the effects of the post-inoculation treatment differed with different viruses. Tomato spotted wilt and tobacco mosaic viruses multiply in plants at 36°, and the post-inoculation treatment reduced the local lesions they caused to numbers that varied between 10 and 90 per cent of the control; these two viruses also have large thermal coefficients of heat inactivation. By contrast, tobacco necrosis, tomato bushy stunt and cucumber mosaic viruses, were much affected by post-inoculation treatment, lesion formation being completely prevented by exposure to 36° for a day or more. These three viruses appear not to multiply in plants at 36°, and although they have high thermal inactivation points, they have small temperature coefficients of thermal inactivation.

The extent to which lesion formation was affected by pre- or post-inoculation exposure of plants to 36° depended not only on the length of treatment, but also on the physiological condition of the plants.

The symptoms of infected plants changed considerably if kept at 36°. At 36° *Nicotiana glutinosa*, inoculated with tobacco mosaic virus, gave chlorotic local lesions instead of necrotic ones, and became systemically infected. When systemically infected plants were brought to ordinary glasshouse temperature, the infected tissues all collapsed and died in a day.

84. KLECZKOWSKI, A. (1953). A method for testing results of infectivity tests with plant viruses for compatibility with hypotheses. *J. gen. Microbiol.* **8**, 295.

A statistical method is described to test the compatibility between results of local-lesion counts and hypotheses relating changes in infectivity of plant-virus preparations to treatments applied to them. The method allows the variance-ratio test to be applied; it involves establishing a relation between numbers of lesions and virus concentration for each experiment and a logarithmic transformation of lesion counts to make variance independent of the magnitude of the variate. Its use is illustrated with results obtained to see whether inactivation of viruses by ultraviolet radiation is a first order reaction.

85. LAST, F. T. (1953). Some effects of temperature and nitrogen supply on wheat powdery mildew. *Ann. appl. Biol.*, **40**. (In the press.)

The wheat variety Red Standard was more susceptible to infection by *Erysiphe graminis* at 14°–20°C. than at 7°C. Conidia were produced per unit area of pustule more than 10 times as rapidly at 14°C as at 7°C.

The increased susceptibility of wheat to mildew after applying nitrogenous fertilizer (N) was associated with changes in its growth rate. Both growth

rate and susceptibility increased to a maximum and then declined; the curves for the two were parallel with a lag of some days between effect on growth rate and effect on susceptibility. Plants which had passed through the susceptible phase and became resistant to mildew, again became susceptible when supplied with more N. Nitrogen-deficient plants continuously resisted infection.

The higher the average growth rate during an experiment the greater was the total amount of infection. Increasing the average growth rate was soon followed by a sharp increase in the amount of infection. When plants of two size groups received the same amount of N the initially smaller plants became more heavily infected than the larger plants.

86. (NUTMAN, F. J.) & ROBERTS, F. M. (1952). Acute die-back of clove trees in the Zanzibar Protectorate. *Ann. appl. Biol.*, **39**, 599.

The most widespread die-back of clove trees (*Eugenia aromatica*) in the Zanzibar Protectorate is caused by *Cryptosporella eugeniae* sp. nov. The most noticeable sympton is the death of a branch or a portion of a branch, or, in young saplings, of the entire tree ; in mature trees infection eventually leads to the semi-moribund trees now common in almost every clove plantation. The fungus invariably enters through a wound, most often one resulting from harvest damage. Pycnidia, and later perithecia, develop near the point of entry. Internally the infected wood is clearly distinguishable from the healthy by a dark red-brown stain.

Experimental infections that reproduce typical symptoms can rarely be caused in plants aged 18 to 36 months, and not at all in young seedlings. Experimental infection of older plants becomes more certain with increasing age, and with saplings of 7–10 years old failure is rare.

The prevalence of *Cryptosporella* die-back is almost entirely attributable to the destructive methods of harvesting now practised, combined with the presence of much infected material present in the plantations. Suggested control measures are based on the removal of old sources of infection and prevention of future damage, combined with remedial treatment where possible.

87. WATSON, MARION A. & HEALY, M. J. R. (1953). The spread of beet yellows and beet mosaic viruses in the sugar beet root crop. *Ann. appl. Biol.*, **40**, 38.

Multiple regression analysis of field data identified alate *Myzus persicae* as the most important factor affecting spread of beet yellows virus. Apterae of *M. persicae* and alatae and apterae of *Aphis fabae* were relatively unimportant.

A simple mathematical model of the spread of infection was developed. Assuming that the crop is visited by N aphids at a time when the proportion of plants infected is k_0, the predicted proportion of infection for a time 3–4 weeks later (k_1) is:—

$$k_1 = k_0 + 100\ (1 - k_0)\ (1 = e^{-NI})$$

where $I = p\ (\ (1 - k_0) + k_0\ t - 1)\ / k_0$

This formula adequately accounts for the observed spread when N=1/10 sticky trap count for the 3–4 weeks preceding the time when k_0 infection is observed;

p=probability of infection by a single aphid=$\frac{1}{2}$

t=number of movements per aphid effective for spreading beet yellows virus =5.

Once virus enters the root crops in spring, spread is mainly within fields, or between fields in the same neighbourhood. Where beet and mangold seed crops are common some plants in root crops become infected by summer migrants from seed crops. However, yellows is also more prevalent in seed-crop areas because the root crops in these areas are more heavily infested with *M. persicae*.

The proportion of plants infected by spring migrants entering the root crops before the end of June is small and variable. It is not significantly different in seed-crop and other areas. This implies either that initial virus comes equally from sources other than seed crops, or that, if the seed crops are the main sources, aphids that acquire virus from them during migration are later very widely dispersed.

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In contrast to yellows, mosaic virus spreads mainly in the neighbourhood of seed crops within the seed-crop areas. No significant relation between aphid numbers and incidence of mosaic was established, but there is a strong suggestion that alatae of *M. persicae* and *A. fabae* spread the virus, and that both species contribute equally. This suggests that mosaic virus is not spread by aphids moving within the root crops, but only by infective migrants coming from outside sources. As the virus does not persist in the aphids, the sources must be near the root crops, and, as there is little spread within a crop, many infective migrants are needed to infect a large proportion of a crop. Seed crops often provide these conditions, as they contain infected plants, and both vector species breed on them. The irregularity of the data relating aphid numbers to mosaic incidence probably has two main causes; (1) differences in the incidence of mosaic in different seed crops, and (2) differences in the proportion of trapped aphids that have migrated from seed crops.

Nematology Department

General Papers

88. Fenwick, D. W. (1952). *Heterodera rostochiensis:* sampling techniques and the limits of their applicability. *Proc. Int. Nemat. Symp.* (1951), 8.

89. Franklin, M. T. (1952). Differentiation of species of *Heterodera*. *Proc. Int. Nemat. Symp.* (1951), 50.

90. Franklin, M. T. (1952). Some plant-parasitic Aphelenchs. Disease symptoms and hosts. *Proc. Int. Nemat. Symp.* (1951), 80.

91. Goodey, J. Basil (1952). The biology and host range of *Ditylenchus destructor*. *Proc. Int. Nemat. Symp.* (1951), 75.

92. Goodey, T. (1952). The present-day importance of *Pratylenchus* species. *Proc. Int. Nemat. Symp.* (1951), 84.

93. Peters, B. G. (1952). *Heterodera rostochiensis:* chemical control methods. *Proc. Int. Nemat. Symp.* (1951), 32.

94. Peters, B. G. (1952). The eelworm problem: biological aspects. Plant eelworms of the genus *Heterodera*. *Chem. & Ind.* (11th Oct.), 994.

95. Peters, B. G. (1952). Control of plant nematodes. *Rep. Progr. appl. Chem.*, **36,** 701.

Research Papers

96. Fenwick, D. W. (1952). The bio-assay of potato root diffusate. *Ann. appl. Biol.*, **39,** 457.

Experiments are described on the number of potato root eelworm larvae hatching in graded dilutions of potato root diffusate. In any sample hatching ability is proportional to the logarithm of its concentration and for each sample there is a " threshold " dilution beyond which it is inactive. Dilution curves for different diffusate samples are parallel. These relationships are utilized for standardizing any given sample.

97. Fenwick, D. W. & Reid, E. (1953). Seasonal fluctuations in the degree of hatching from cysts of the potato root eelworm. *Nature, Lond.*, **171,** Jan. 3, 17.

It is recorded that for the past three years hatching tests have been conducted throughout the year without any apparent diminution in the " hatchability " of cysts in winter time. The conditions of storage of cysts are described and it is concluded that the low hatches in winter months encountered by other workers result from the influence of the external environment.

98. Goodey, J. Basil (1952). Investigations into the host ranges of *Ditylenchus destructor* and *D. dipsaci*. *Ann. appl. Biol.*, **39,** 221.

Parasitism of (1) *Humulus lupulus,* (2) *Syringa vulgaris,* (3) *Tigridia pavonia,* (4) *Begonia tuberhybrida,* (5) *Gladiolus hybridus* and (6) *Tropaeolum*

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polyphyllum which had been ascribed to *Ditylenchus dipsaci* was confirmed for (3), (4) and (5). *D. destructor* was found to attack all these except (4) and also to attack a new host, *Stachys palustris*.

99. Goodey, J. Basil (1952). *Tylenchorhynchus tessellatus* n.sp. (Nematoda: Tylenchida). *J. Helminth.*, **26,** 87.

100. Goodey, J. Basil (1952). *Rotylenchus coheni* n.sp. (Nematoda: Tylenchida) parasitic on the roots of *Hippeastrum* sp. *J. Helminth.*, **26,** 91.

101. Goodey, J. Basil. (1952). The influence of the host on the dimensions of the plant parastic nematode *Ditylenchus destructor*. *Ann. appl. Biol.*, **39,** 468.

Measurement data obtained from 11 populations of *D. destructor* indicate the significant effect of the host on the parasite. The essential importance of structural characters and the care with which measurements must be used, in the identification of a species, are emphasized.

102. Hesling, J. J. (1952). An improved method of separating eelworm cysts from debris. *J. Helminth.*, **26,** 69.

Hesling describes an adaptation of the entomologists' aspirator which has proved useful for picking up cysts of *Heterodera* species from the débris obtained when they are floated out of dried soil. The manipulation of the aspirator, and the part played by the apparatus in simplifying the estimation of *Heterodera* infestations in soils are fully explained.

103. Peters, B. G. (1952). Toxicity tests with vinegar eelworm. I. Counting and culturing. *J. Helminth.*, **26,** 97.

The vinegar eelworm is a useful laboratory animal which can be used in nematicidal work. Methods of culturing the worm in vinegar, 4 per cent sugar or 4 per cent ethanol solutions are described. Counts of worms in a 1 ml. counting slide are shown to conform with Poisson expectation. The negative geotropism of these worms is made use of by inducing them to climb from a dirty culture into clean medium: this also concentrates them.

104. Peters, B. G. (1952). Pot tests of nematicides against potato root eelworm. I. Pilot test and methods. *Ann. appl. Biol.*, **39,** 447.

Nematicides are applied to infested soil in glazed pots holding 20 lb. After some 4 weeks the soil is sampled to measure the eelworm kill, and a potato tuber is then planted in each. Height of haulms and weight of crop give evidence of phytotoxic or stimulating effects on the plants, and an end-of-season soil sample shows the extent to which the eelworm population has recovered from its initial set-back. Eelworm counts are handled in logarithmic transformation by analysis of variance, though probit analysis should also be practicable.

Insecticides and Fungicides Department

105. Glynne-Jones, G. D. (1952). The responses of the honey bee to repellent chemicals. *J. exp. Biol.*, **29,** 372.

1. This paper is concerned, first, with the development of a technique for maintaining a population of honey-bees (*Apis mellifera*) under conditions where it does not have access to naturally secreted nectar, but is allowed free flying conditions, and secondly with the application of this technique to the study of the chemotropic responses of bees to repellent chemicals.

2. Two types of stimuli are considered:
   (*a*) The effect of the addition of the repellent to an attractant (sucrose solution).
   (*b*) The effect of the repellent in the vapour phase in the vicinity of the attractant.

In (*a*) techniques are described for measuring the response with the standard attractant alternating in time and space.

3. Data collected on the rejection thresholds of acetic acid and phenol showed that whilst little variation in response occurred at the higher concentrations of the repellent, the offering of the standard attractant alternating

in time as opposed to space greatly modified the response. Tests were carried out to determine the reproducibility of the results.

4. It would appear that for a repellent chemical to be capable of effectively reducing the number of visits to a source of food, it must be capable of irritating the common chemical senses of the bee.

106. GLYNNE-JONES, G. D. & EDWARDS, R. A. (1952). Studies of toxicity of 3:5 dinitro-orthocresol and its sodium salt to the honey bee. *Bull. ent. Res.*, **43**, 67-78.

Laboratory and field experiments were carried out to study the toxicity of 3:5 dinitro-ortho-cresol and its sodium salt to the honey bee.

The acid DNOC was shown to be a rapidly acting poison under a wide variety of conditions and its toxicity was not greatly affected by differences in temperature or humidity during or after treatment.

Although both the acid and salt were equally toxic as stomach poisons, considerable differences were observed between the two substances as aqueous sprays and dry films. The toxicity of the sodium salt as an aqueous spray was considerably influenced by the humidity of the environment after spraying; the higher the humidity the greater the kill.

The sodium salt was apparently non-toxic as a dry film and increasing the humidity of the environment had no effect until the saturation point was reached and the salt went into solution. At this point the salt was almost as rapid in action as the acid. The type of surface on which the film was deposited was also shown to affect the toxicity.

Experiments were carried out on the penetration of the two substances through beeswax and these confirmed that whilst the acid could penetrate the beeswax in all forms tested, the salt would only penetrate in aqueous solution.

The effects of the acid DNOC on a population of foraging bees when used as a herbicide to control charlock in a 20-acre field of spring oats was investigated. It was shown that whilst the population of foraging bees was reduced no appreciable damage was inflicted on the colony. It is considered that at temperatures when active foraging on charlock takes place, spraying with DNOC will be followed by a rapid wilting of the flowers which will render them unattractive as sources of nectar or pollen.

107. LORD, K. A., WARD, J. (CORNELIUS, J. A. & JARVIS, M. W.) (1952). Chromatographic separation of the pyrethrins. *J. Sci. Fd. Agric.* No. 9, 419.

'Pyrethrins' I and II have been separated on both alumina and silica columns. On alumina columns there is some evidence of the separation of the cinerins from the pyrethrins.

Material separated in this way has been used to elucidate separations obtained by chromatography of pyrethrum extracts on paper impregnated with alumina and by paper chromatography of 2:4 dinitrophenyldrazine derivatives of the 'pyrethrins'.

108. POTTER, C. (1952). An improved laboratory apparatus for applying direct sprays and surface films, with data on the electrostatic charge on atomised spray fluids. *Ann. appl. Biol.*, **39**, 1-28.

A description is given of the design and performance of a laboratory spraying apparatus which is an improved design on that described by the author in 1941. This apparatus is shown to be capable of giving a good replication and an even distribution over a circular area of 9 cm. in diameter with distilled water, a light petroleum oil and a heavy petroleum oil.

The effect of changes of temperature and humidity on the deposit are given. Some results are given of an investigation of the electrostatic charge produced on the droplets of distilled water and aqeuous solutions of wetting agents when these liquids are sprayed in the apparatus. The charge varied greatly with the solution, in the presence of two non-ionic surface active agents the charge was greatly increased over that with distilled water, while in the presence of an anionic material it was reduced so that it could not be measured with the available apparatus. There was however no correlation between the charge on the droplets and the amount deposited and this together with the evidence obtained by applying potentials up to 1·5 K.V.

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on the spray target indicated that variations in electrostatic charge were not likely to cause variations in the amount deposited. It was concluded that the recorded variation in the amount deposited was probably due to variations in the amount of turbulence occurring in the spray tower. References are given to work illustrating the biological results obtained with the apparatus.

109. POTTER, C. & LORD, K. A. (1952). The problem of the estimation of the insecticidal activity of pyrethrum by biological and chemical methods. *Pyrethrum Post.*, **3**, 12.

The problem of pyrethrum estimation has been reviewed and the merits of existing biological and chemical assay methods compared. It is concluded that none of the current methods of assay is entirely satisfactory, and that the present position would be improved if all the active constituents were isolated and separated in a pure unchanged state and their chemical, physical and biological activities examined both separately and in combination.

Entomology Department

110. BARNES, H. F. (1952). Plant Galls. *Bedfordshire Naturalist*, **6**, 24.

A popular account.

111. BARNES, H. F. (1952). Studies of Fluctuations in Insect Populations. XII. Further evidence of prolonged larval life in the wheat-blossom midges. *Ann. appl. Biol.*, **39**, 370.

The larvae of *Contarinia tritici* sometimes remains in the soil three winters before emerging as adult midges; the appearance of their parasites similarly is sometimes delayed two years. *Sitodiplosis mosellana* remains as larvae in the soil up to the twelfth summer after feeding in the wheat ears; in 1951 midges emerged from larvae that had been in the wheat in 1939, although some of these larvae had emerged as adult midges in all but two of the intervening years. Its parasites continue emerging for six years.

112. BARNES, H. F. (1952). Studies of Fluctuations in Insect Populations. XIII. An improved method of ascertaining the correct date to sample when assessing larval infestations of the wheat-blossom midges. *Ann. appl. Biol.*, **39**, 374.

Since the larvae only leave the ears during moist conditions, sudden diminutions in the infestations in the ears sometimes occurs after precipitation following a dry spell, thus leading to an erroneous assessment of the year's infestation. A method of taking small samples frequently during the period of larval growth allows any such errors in the main sampling to be rectified.

113. JOHNSON, C. G. (1952). A new approach to the problems of the spread of aphids and to insect trapping. *Nature, Lond.*, **170**, 147.

In view of the findings in the above mentioned work, it is now necessary to reconsider the epidemiological significance of research on aphid flight. Hitherto, most attention has been focussed on the problem of aphis migration and the conditions which control it. The significant approach now appears to be rather to study the reverse of this situation—namely the conditions which favour the *alighting* of aphids and the factors about the crops which encourage this.

114. JOHNSON, C. G. (1952). The changing numbers of *Aphis fabae Scop.*, flying at crop level, in relation to current weather and to the population on the crop. *Ann. appl. Biol.*, **39**, 525.

The current view that aphid migration is largely confined to calm weather and that this is controlled by the willingness or reluctance of aphids to take flight according to the strength of the wind can no longer be held. This paper shows that most migration occurs in windy weather (although the highest local *concentrations* are confined to calm periods), and that it is controlled mainly by population, not behaviour, changes.

115. JOHNSON, C. G. (1952). The bedbug. *New Biol.*, **13**, 80.

116. JOHNSON, C. G. (1953). The aerial dispersal of aphids. *Discovery*. **14**, 190

A popular account of the work in progress on aphid migration and especially the work on high altitude aerial drift.

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117. JOHNSON, C. G. (1952). The infestation of beans by the Black Aphid *Aphis fabae* Scop. *J. R. agric. Soc.* **113,** 70.

An account of recent work on the rôle of weather in aphid migration and of the pattern of infestation of bean fields by the black bean aphid in relation to the prevailing wind direction.

118. LONG, D. B. (1953). Some problems of polymorphism in insects. *Proc. R. ent. Soc., Lond.*, A. **27,** 99.

A review of literature illustrating some of the factors involved in polymorphism. The problem has been considered from the separate standpoints of the effect of the genetic constitution in producing variation and the effect of environmental factors which induce modifications as distinct responses.

119. MURPHY, P. W. (1953). The biology of forest soils with special reference to the Mesofauna or Meiofauna. *J. Soil Sci.* (In the press.)

A review of the meso- and meio-fauna of forest soils from quantitative and qualitative points of view. The meio-fauna are broadly defined as those members of the Arachnida, Myriapoda and Insecta which are readily obtained by the funnel method of extraction. Details of the magnitude, nature and vertical distribution of the fauna of a Yorkshire heathland before and after afforestation are included. The pedological and biotic factors in the formation of mull and mor are considered. There is a discussion of the habits of soil fauna especially their role in the breakdown of tree litter; and the interplay of soil, tree species and fauna in the development of productive forests both for present and succeeding crops. The paper concludes with a brief appraisal of the influence of forestry practice in creating conditions which favour the development and maintenance of beneficial soil organisms.

120. RAW, F. (1951). The ecology of the Garden Chafer *Phyllopertha horticola* L. with preliminary observations in control measures. *Bull. ent. Res.*, **43,** 605.

An account is given of biological and ecological work carried out in S.W. England. *P. horticola* occurs naturally in poor quality permanent grassland on light soils. In some districts, e.g. North Wales, Dorset Downs, Lake District, it is a major pest.

The females lay about 14 eggs. Fecundity is correlated with weight which is related to larval food supply. Natural limitation of weight through competition for food among larvae may occur. Females will mate and lay fertile eggs without feeding and in general adult feeding does not affect fecundity. Over 90 per cent of eggs laid are fertile but fertility decreased with the age of the adult. The incubation period is about a month.

In the field eggs are laid in groups in the topsoil. The larvae gradually disperse but may regroup later at feeding sites. Larval mortality was highest where the turf was damaged. Population changes were related to adult dispersal, density of vegetation, consolidation, soil moisture and predators. Predation by birds can greatly reduce larval density.

Weeds are unaffected by infestation and damage is chiefly due to destruction of grasses. *Brachypodium pinnatum* is resistant because of its tough rootstock, *Dactylis glomerata* and *Lolium perenne* are relatively resistant, *Poa* spp. and *Festuca* spp. are readily damaged but regenerate when feeding stops or infestation declines. The distribution of *Poterium sanguisorba*, a favoured food plant may influence the distribution of *P. horticola*.

When infestation is severe and the grass roots are destroyed the soil aggregates are broken down. Soil structure is restored when the grasses regenerate and by consolidation.

Infestation was reduced by ploughing and reseeding. Dusting with 3·5 per cent B.H.C. at 70 lb. per acre during the flight period gave promising results when applied in favourable weather.

121. WILLIAMS, C. B. (1953). The international aspects of insect migration and insect drift. *Trans. 9th Int. ent. Congr.* **1**. 63.

A survey of our knowledge about the distances that insects travel, both by deliberate migration and by being blown by air currents, and a discussion of the importance of this in international problems of the spread of insects from one country to another, and the value of frontier inspections as a means of protection.

122. WILLIAMS, C. B. (1953). Graphical and statistical methods in the study of insect phenology. *Trans. 9th Int. Ent. Congr.* **2**,174

In the study of the dates of occurrence of biological events—such as the hatching of the eggs or the emergence of an adult insect—or the flowering of a plant or the arrival of a migrant bird—it is possible to compare results in different localities in the same year, or in the same locality in different years, and also at times a sequence of events in the same locality in the same year. There is also the interfering effect of the difference between different observers. Methods are discussed of laying out large numbers of records of this type in the form of diagrams to enable the basic facts to be easily seen. And also simple statistical methods for assessing the extent of the " errors " and hence the reliability of any conclusions.

123. WILLIAMS, C. B. (1953). The relative abundance of species in mixed animal populations. *J. Anim. Ecol.*, **21.** (In the press.)

A study was made of the frequency distributions of the abundance of different species in random samples of insects and birds taken from wild populations, and it is shown that while small samples tend to resemble the logarithmic series, when the samples are large (and so more likely to resemble the population sampled) the distribution is closer to the log-normal distribution than to the logarithmic series.

Bee Department

124. ABBOTT, C. P. & BUTLER, C. G. (1952). The scientist and the ciné camera. *Rep. Cent. Ass. Beekeep.*, Oct.

The use and value of the ciné camera as a tool in bee research, particularly with respect to investigations on bee behaviour, are discussed.

125. BAILEY, L. (1952). The action of the proventriculus of the worker honeybee, *Apis mellifera*. L. *J. exp. Biol.*, **29,** 310.

A detailed account is given of the method of filtration of small particles (pollen grains and Nosema spores) by the proventriculus from the honey-stomach. The rates of filtration of different concentrations and sizes of particles, and of different volumes of suspensions, are analysed and the possible physiological significance of the filtration activity is discussed.

126. BUTLER, C. G. (1952). The development of British honeybees. *Rev. Ass. Agric., Lond.*, **17,** 9.

A discussion of the development of the strains of honeybees in Britain today, together with some views with regard to their future development.

127. BUTLER, C. G. (1952). Behaviour of social insects. *Nature, Lond.*, **170,** 642.

A synopsis of the papers on this subject read during the Belfast meeting of the British Association.

128. BUTLER, C. G. & FREE, J. B. (1952). The behaviour of worker honeybees at the hive entrance. *Behaviour*, **4,** 262

Guard bees are not found at the hive entrance unless their colony has been alerted by the presence of robber bees or numbers of bees that have strayed from other colonies, or by disturbance of some kind. The degree of alertness exhibited varies under different conditions and with different strains of bees and may be of short or long duration. Intruders are not molested by unalerted colonies. Bees of various ages undertake guard duties and attempt to intercept and inspect other bees on the alighting-board of the hive. They recognise members of their own colony and distinguish them from bees from other colonies very quickly by scent. Robber bees are, however, recognised as such by their actions before the guards can approach and examine them.

On interception the fate of intruders is largely dependent upon their subsequent behaviour. The guards immediately try to sting robbers and will also fight violently with guard bees from other colonies, but very seldom attack other intruders. Many intruders adopt a submissive attitude and exhibit the ' displacement activity ' of tongue-stropping, sometimes passing into a state of thanatosis. A high proportion of submissive intruders are mauled and dragged away from the hive entrance irrespective of their age; however, those that do succeed in remaining in a strange colony for a few hours become accepted by the bees of that colony.

129. HASSANEIN, M. H. (1951). The influence of *Nosema apis* on the larval honeybee. *Ann. appl. Biol.*, **38,** 844.

It was found to be impossible to infect the larval honeybee with *Nosema apis*. In colonies suffering from this disease about 15 per cent of the eggs laid failed to result in adults, probably because of inadequate care and feeding.

130. (KALMUS, H.) & RIBBANDS, C. R. (1952). The origin of the odours by which honeybees recognise their companions. *Proc. roy. Soc. B.*, **140,** 50-59.

Bees from two colonies were trained to forage from different dishes, placed one yard apart. Their thoraces were distinctly marked. Recruits to the dishes were also distinctly marked, and they were found to be preferentially attracted to the dish visited by members of their own colony.

Recruits were not attracted to the dishes by the sight or sound of their companions. They were attracted by their distinctive odour. These odours were not inherited, but were produced by changes in the food supply of the colonies. They would develop between queenless halves of colonies.

Uniform and distinguishable colony odours are a consequence of the widespread food transmission which takes place amongst the foragers of each colony. Their rôle in orientation and the defence of the honeybee community is discussed.

131. NIXON, H. L. & RIBBANDS, C. R. (1952). Food transmission in the honeybee community. *Proc. roy. Soc. B.*, **140,** 43-50.

Six bees were trained to a dish, from which they collected 20 ml. of sugar syrup containing radioactive phosphorus. The distribution of radioactivity among the bees and larvae of their colony of 24,500 adults was then studied.

62 per cent of the foragers and 16–21 per cent of all the bees in the hive were radioactive within 4 hours. 76 per cent of the foragers and 43–60 per cent of all the bees were radioactive within 27 hours. The nurse bees were significantly less radioactive than the house bees and the foragers significantly more so. Within 48 hours all the large larvae in the unsealed cells were radioactive. The results are attributed to widespread food transmission.

It is suggested that food transmission is the foundation of the division of labour within the honeybee community, and of the similar odour produced by the members of each colony which serves for mutual recognition.

Food transmission would enable slow-acting insecticides contained in their food to be widely distributed among the members of a honeybee colony.

132. RIBBANDS, C. R. (1952). Division of labour in the honeybee community. *Proc. roy. Soc. B.*, **140,** 32-43.

Newly emerged bees in a colony were individually marked and their foraging activities were studied by subsequent observations at the hive entrance.

A few individuals gathered pollen throughout their foraging lives; many gathered none at all. Most gathered pollen at some time, but there was great diversity in the part of the foraging life at which this occurred.

There was considerable variation in the age at which different bees, emerging on the same day and living in the same colony, commenced foraging; this age ranged from 9–35 days. This variation was produced not only by alteration of the duration of the various hive duties, but also by omission of some of them. Such variation indicates that the division of labour is not determined by the age of the available workers, but is controlled by the requirements of the colony, the ages of the bees playing a subsidiary rôle.

The requirements of the colony are determined by its food supply, and they are appreciated by the individual as a consequence of widespread food transmission. Food transmission is, therefore, the most primitive and important method of communication in the honeybee colony.

133. RIBBANDS, C. R. (1952). The relation between the foraging range of honeybees and their honey production. *Bee World*, **33,** 2.

The gains in weight of groups of colonies sited on the edges of crops were compared with those of groups of colonies sited $\frac{3}{8}$ and $\frac{3}{4}$ mile away from the same crops. The experiments were repeated in two successive years. The effect of increased flying distance was large and detrimental, but its magnitude varied considerably. Most of the effect was due to weather conditions.

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The results emphasize the importance of foraging range, and demonstrate how slight differences in apiary position or weather may cause the complete loss of a honey crop. They illustrate the advantages of moving colonies of bees to suitable crops and of using small apiaries.

134. RIBBANDS, C. R. (1952). The inability of honeybees to communicate colours. *Brit. J. anim. Behav.*, **1.** (In the press.)

Experiments determined that dancing foragers which can communicate the scent and whereabouts of a crop to other members of their colony, do not convey any information concerning the colour of the flowers of the crop.

135. RIBBANDS, C. R. (KALMUS, H.) & NIXON, H. L. (1952). New evidence of communication in the honeybee colony. *Nature, Lond.*, **170.**, 438. Reprinted in *Bee World*, **33.** (In the press.)

An article based upon the three papers summarized above and published in *Proc. roy. Soc. B.* **140,** 32.

136. SIMPSON, J. (1952). The composition of the stores produced by bees from sugar syrup. *Bee World*, **33,** 112.

The water content of stores derived from sucrose syrup was normal but the sucrose content was much higher than that of normal honey and was greater when the stores were produced from concentrated syrup than from dilute. The extent to which honey granulates is diminished by raising its sucrose content to that of stores derived from sucrose syrup. Although bees can effectively ingest *finely* granulated honey, granulation is in general undesirable, thus the presence of sucrose in syrup stores is probably beneficial.

137. WYKES, Gwenyth R. (1952). An investigation of the sugars present in the nectar of flowers of various species. *New Phytol.*, **51,** 210.

Quantitative determinations were made of nectar sugars by means of paper chromatography. In nectar obtained from 61 species sucrose, glucose and fructose were present in all but one sample. In addition, maltose and two other sugars of low RF values were found in the nectar of some species.

138. WYKES, Gwenyth R. (1952). The influence of variations in the supply of carbohydrate on the process of nectar secretion. *New Phytol.*, **51.** (In the press.)

The supply of carbohydrate available to nectar-secreting flowers was varied by different treatments and the influence of such variations on the amount and sugar concentration of nectar secreted was determined. Application of ringing and defoliating treatments to flowering shoots showed that the supply of carbohydrate may become a limiting factor for nectar secretion. In a series of sugar-feeding experiments it was found that the concentration of nectar and the amount of sugar secreted varied directly with the sugar concentration of the feeding solution, whereas the weight of nectar did not. Differences in the kinds of sugars supplied did not appear to influence nectar content.

139. WYKES, Gwenyth R. (1952). The preferences of honeybees for solutions of various sugars which occur in nectar. *J. exp. Biol.*, **29.** (In the press.)

When bees were offered equal volumes of sugar solutions, of different composition but the same total concentration, in laboratory and field experiments, it was found that sugars which occur in nectar were not equally attractive to them. Consistent preferences were shown for solutions of single sugars in the following descending order:—sucrose, glucose, maltose, fructose. The acceptances of some mixtures differed from those predicted on the basis of an additive effect of the constituent sugars in single solution. High preferences were shown for sucrose-glucose-fructose solutions.

No direct relationship appears to exist between the chemical constitution of the sugars offered and their acceptance by bees, and no adequate explanation can be offered for the observed differences in preferences for solutions of either single or mixed sugars.

The possible biological significance of such selective responses by bees is discussed.

Statistics Department

140. BOYD, D. A. *et al.* (1953). The Rothamsted experiments on field beans. Part I. Manuring and cultivation of field beans. *J. R. agric. Soc.*, **113**, 59.

This paper gives the results of experiments on the cultivation and manuring of beans carried out at Rothamsted in recent years together with some indication of the results obtained at other centres. The manurial experiments showed that a very good manuring for beans consists of ploughing in a moderate dressing of farmyard manure; where this is done it is unnecessary to apply fertilizer except on soils believed to be low in phosphate or potash. Where no farmyard manure is available the main need is for potash fertilizer while for phosphate it is difficult to justify any more than a very small dressing. Nevertheless in many counties a substantial proportion of farmers apply phosphate to beans whereas few of those not using farmyard manure apply potash. It is wasteful to use nitrogen on winter beans and it is of doubtful value for the spring crop.

Experiments comparing a PK fertilizer placed in bands near the seed compared with the same fertilizer broadcast showed that for both winter and spring beans placing a single dressing of fertilizer beside the seed gave yields as high as or higher than twice as much broadcast. For fertilizer sown in this way quite small dressings were adequate.

The main findings of the experiments on other husbandry factors are in favour of generous seed rates and early sowing; up to 3 cwt. seed per acre has proved to be profitable and sowing in early October has given better yields than sowing in late October or November. Increased seeding only partially compensates for late sowing. No difference was found between broadcast before ploughing and dropping the seed in the furrow by an attachment on the plough beam.

141. CHURCH, B. M. (1952). Recent trends in fertilizer practice in England and Wales. Part I. The national position. *Emp. J. exp. Agric.*, **79**, 249. Part II. The use of fertilizers on cereals, root crops and grassland. *Emp. J. exp. Agric.*, **80**, 257.

Information is presented on the changes which took place between 1944 and 1950 in farmers' use of fertilizers. This data has largely been obtained from the results of fertilizer practice surveys carried out in eight districts in England and Wales in 1944–5 and in 1950. Estimates are made of the proportions of total fertilizer supplies used on different crops, and trends in the use of fertilizers on individual crops are examined. As far as the limited survey material allows, differences in the use of fertilizers in districts of different farming types are discussed. The times and methods of application of fertilizers to cereals in 1950 are examined and attention is drawn to the possibilities of increasing production by the more general use of fertilizers on cereals, fodder roots and grassland.

142. GRUNDY, P. M. (1952). The fitting of grouped truncated and grouped censored normal distributions. *Biometrika*, **39**, 252.

The fitting of a normal distribution, when all observations below some fixed value are wholly ignored ('truncated') or merely enumerated ('censored'), has been discussed by various authors. Fresh problems arise when the data are grouped, a situation relevant in entomological work. The present paper gives a solution of these problems, involving simple adjustments to the sample moments and to the estimated variances of the estimates.

143. GRUNDY, P. M. & LEECH, F. B. (1953). A nomogram for assays arranged in randomized blocks. *Brit. J. Pharmacol.* (In the press.)

A scheme based on a nomogram has been devised for the routine computation of the 5 per cent fiducial limits of the relative potency of an assay arranged in randomized blocks. An illustration is given of the appropriate method of obtaining a range estimate of error.

The theory and construction of the nomogram are discussed; a table of the co-ordinates of the curves is provided to facilitate the construction.

Range is shown to be a reliable estimator of the error of tuberculin assays.

The magnitude of the interactions of "materials" and "slope" with blocks has been investigated. It is shown that in tuberculin assays they may be large and must therefore be eliminated from the estimate of error.

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144. HEALY, M. J. R. (1952). The analysis of lattice designs when a variety is missing. *Emp. J. exp. Agric.*, **20,** 220.

The intra-block analysis is given for simple, triple and balanced lattices with one variety missing. When the incomplete blocks have not been successful in eliminating soil variability, a randomized block analysis is recommended.

145. HEALY, M. J. R. (1952). Some statistical aspects of anthropometry. *J. R. statist. Soc. B.*, **14,** 164.

This paper deals with some statistical problems arising in the treatment of anthropometric data on a large scale. Its aim is not so much to develop new statistical methods as to apply critically well-known regression techniques. The first part of the paper discusses the problem of collecting and recording the data in a way that will minimize the number of gross errors and will be well adapted to the subsequent computing processes. The rest of the paper exhibits three typical anthropometric problems and suggests appropriate methods of tackling them.

See also No. 87.

146. HODNETT, G. E. (1953). The responses of sugar cane to fertilizers in Trinidad. *Emp. J. exp. Agric.* (In the press.)

Using experimental results obtained within the past 20 years in Trinidad, mean standard responses of plant canes, first ratoons and second ratoons to nitrogen, phosphate, potash, pen-manure and by-products have been obtained. Responses to nitrogen have been associated with the moisture characteristics of the soils while those of phosphate and potash depend rather on the quantities of these nutrients available in the soils. In this series of experiments there were no great differences in response of plant canes and ratoons. The newer varieties showed rather greater responses than the old. Nitrogen and phosphate somewhat reduced the sugar percentage while potash increased it.

147. HODNETT, G. E. (1953). A uniformity trial on groundnuts. *J. agric. Sci.* (In the press.)

A uniformity trial on groundnuts has been analysed and the results discussed. Plant number is less variable than yield and less sensitive to shape of plots and of blocks. For yield, long narrow plots are more efficient than shorter wider plots, in all shapes and sizes of blocks and in Latin squares. The plots should not be arranged end to end along the contours, but side by side, either singly or in pairs, forming compact blocks.

The regression of the plot variance of the mean yield per unit area on size of plot approximately follows a linear logarithmic relationship. A similar relationship holds for plant number. The value of the regression coefficient b' is low and it has been shown that, as expected, there is considerable gain from the use of small blocks. The efficiencies of various confounded and incomplete block designs relative to designs in larger blocks have been determined for some particular layouts, and values for other layouts, ignoring shape of plots and of blocks, have been obtained by interpolation.

The field used for this uniformity trial appears equally variable in all directions.

148. (MANDL, A. M., ZUCKERMAN, S.) & PATTERSON, H. D. (1952). The number of oocytes in ovarian fragments after compensatory hypertrophy. *J. Endocrinol.*, **8,** 347.

The results, analysis and interpretation of experiments on rats, designed to determine whether a fragment of ovarian tissue is able to generate new oocytes or alternatively whether the number of oocytes is related to the size of the fragment, are discussed.

149. PATTERSON, H. D. (1953). The analysis of the results of a rotation experiment on the use of straw and fertilizers. *J. agric. Sci.*, **43,** 77.

Methods of analysis applicable to the results of experiments involving a fixed rotation of crops are described, with particular reference to the Rothamsted three-course rotation experiment. The main topics are (1) the estimation of mean treatment effects over all years, and of differential rates of change produced by the treatments; (2) the determination of the errors of the estimates, and (3) the relationships between yields and uncontrolled factors.

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150. YATES, F. (1952). Principles governing the amount of experimentation required in developmental work. *Nature, Lond.*, **170,** 138.

The most economic amount of experimentation can be determined by minimising the sum of the cost of the experiments and the expected losses due to errors in the results. The application of this principle to the case in which it is necessary to determine the optimal level of application of some treatment is developed. The amount of experimentation undertaken on fertilizers for sugar beet is discussed in the light of these results.

REVIEWS, ETC.

151. BOYD, D. A. & DYKE, G. V. (1952). The place of statistics in field experiments. *N.A.A.S. quart. Rev.*, **15,** 93.

152. HEALY, M. J. R. (1952). "Statistical method in biological assay," by D. J. Finney. *Ann. appl. Biol.* (In the press.)

153. HEALY, M. J. R. (1952). "Statistical methods for chemists," by W. J. Youden. *J. R. statist. Soc. A.*, **115,** 437.

154. HODNETT, G. E. (1952). "Statistics for colonial agriculture." Colonial Res. Publns. No. 11. *Nature, Lond.*, **170,** 26.

155. YATES, F. (1952). "George Udny Yule. 1871-1951." *Obit. Not. Roy. Soc.*, **8,** 309.

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156. BOYD, D. A., DYKE, G. V. & LESSELLS, W. J. (1952). Survey of restored opencast coal sites.

157. BOYD, D. A. (1952). Survey of restored opencast coal sites; relative yields of cereals on worked land and on unrequisitioned land on the same farm (West Riding, 1952). Preliminary report.

158. CHURCH, B. M., (BLENKINSOP, A.) *et al.* (1952). The Survey of Fertilizer Practice, 1952.

159. LEECH, F. B. (1952). The effect on the health of lactating cows of treatment with galactopoietic doses of thyroxine or iodinated casein. A.R.C. Report 338/52.

160. SLATER, J. K. W. (1952). Pilot survey of the mechanical conditions and fuel consumptions of agricultural tractors.

161. WITHERS, F. W. (1952). Collection of data on the incidence of disease in dairy herds in Surrey and Berkshire. Statistics from 1st October, 1950 to 30th September, 1951.

Woburn Experimental Station

162. BARNES, T. W. (1952). The behaviour of nitrogenous materials buried in the soil. Part II. The solubilization of nitrogen under full aeration, for long periods. *J. agric. Sci.* (In the press.)

163. MANN, H. H. & BARNES, T. W. (1952). The mutual effect of ryegrass and clover when grown together. *Ann. appl. Biol.* (In the press.)

GENERAL PUBLICATIONS

164. GARNER, H. V. (1952). Manures and Fertilizers. *Bull. Minist. Agric., Lond.*, 24.

165. OGG, *Sir* W. G. (1952). Modern developments in soil science (Fernhurst Lecture). *J. R. Soc. Arts, C.*, 365.

166. OGG, *Sir* W. G. (1952). The Characteristics of Soil. A review of some Recent Developments. *Times Rev. Progr. Sci.*, **5,** 12.

167. OGG, *Sir* W. G. (1952). Work in Progress at Rothamsted. *Times Rev. Agric.*, **3,** 5.

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