

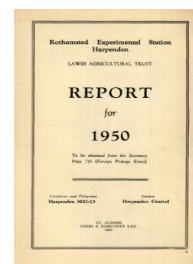
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## Report for 1950

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## Departmental Publications / Abstracts of Papers

### Rothamsted Research

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## PUBLICATIONS

### Physics Department

1. SCHOFIELD (R. K.). 1950. *Soil moisture and evaporation*. (Trans. Fourth Int. Cong. Soil Sci., 2, 20-28.)

The evaporation (transpiration) from an area of land covered with active green vegetation cannot exceed a well defined maximum value which depends almost entirely on meteorological conditions, but may fall below this value if the water supply is inadequate. When the water supply is inadequate to maintain evaporation at this maximum rate, it is certainly inadequate to maintain maximum growth rate if other factors are favourable. Whether a water supply that is adequate for maximum evaporation will always give the greatest growth permitted by other limiting factors is not certain, but in recent experiments on the application of spray irrigation to sugar beet, substantial increases in yield were obtained by applying water calculated to be just sufficient to maintain maximum evaporation, but no further benefit was obtained from applying greater amounts of water.

2. PENMAN (H. L.) and SCHOFIELD (R. K.). 1950. *Some physical aspects of assimilation and transpiration*. (Proc. Conf. Soc. Exp. Biol. [In the press.]

Assimilation and transpiration can be treated as formally identical apart from a change in sign of the concentration gradient. The diffusive flow of carbon dioxide and water vapour is hindered by resistance arising partly outside the leaves and partly in the epidermis. Combination of the results of recent Rothamsted work on the physics of evaporation with a suggestion of Maskell's and some of the results of Brown and Escombe leads to a quantitative estimate of assimilation rates for indoor conditions which is of the right order. For outdoor conditions the length of daylight must be taken into account, and it is shown that the theoretical ratio of transpiration from turf to evaporation from open water agrees quite well with the value found experimentally. Extension to assimilation is attempted through evaluation of a "transpiration ratio"—normally a useless concept—for the limiting case when absorption is complete at the surface of the mesophyll tissue. It is shown that the very variable observed values of this ratio are many times the limiting theoretical ratio, i.e. that assimilation rates are never more than a very small fraction of what they could be. The discrepancy is attributed to the building up of relatively high carbon dioxide gas concentrations inside the leaf—almost reaching the normal atmospheric value—because the transfer of material in solution is much too slow to remove the absorbed carbon dioxide as fast as gaseous diffusion could supply it.

3. PENMAN (H. L.). 1950. *Recent Rothamsted studies in natural evaporation*. (Landbouwkundig Tijdschrift, 62, 166-178.)

A survey of the energy balance method of estimating evaporation from weather data with applications to irrigation, field drainage, and river flow.

4. PENMAN (H. L.). 1950. *The diffusion of moisture through flax seed*. (British J. App. Phys., 1, 213.)

A theoretical calculation confirming experimental value obtained elsewhere.

5. PENMAN (H. L.). 1950. *The water balance of the Stour catchment area*. (J. Inst. Water Eng., 4, 457-469.)

The change in storage in a catchment area is the difference between rainfall and run-off, minus the evaporation loss. From measured values of rainfall and run-off, and from estimated values of evaporation based on weather data and an assumed nature of the vegetation in the area, it has been possible to estimate month-by-month changes in storage from 1933 to 1948. These changes show an annual cycle imposed on long-term trends and conform very well to the similar cycle and trends of observed movement of well-level. The treatment reveals that the month of minimum run-off is normally the last summer month in which evaporation exceeds rainfall; that the storage is, on average, a minimum in September and a maximum in March, the level of a deep well lagging about two months behind; that the average evaporation is very nearly constant at 20 in. per year; and that the

estimate of this annual total is not greatly dependent upon the assumptions made about the distribution of vegetation in the catchment, although the monthly estimates will be so dependent.

6. PENMAN (H. L.). 1950. *Evaporation over the British Isles*. (Q. J. Roy. Met. Soc., **76**, 372-383.)

Theoretical value of average annual evaporation from the British Isles are calculated from long-term averages of air temperature, duration of sunshine, vapour pressure and wind speed for about a hundred stations. Direct estimates of the same quantity are obtained from long-term averages of annual rainfall and annual run-off from about forty catchment areas. The two kinds of estimate agree and are plotted on a map to show the geographical variation evaporation. This shows an increase from 14 inches per annum in Scotland to 20 inches along the south coast of England.

### Chemistry Department

7. ARNOLD (P. W.). 1950. *The nature of precipitated calcium phosphates*. (Trans. Faraday Soc., **46**, 1061-1072.)

The absolute concentrations as well as the relative amounts of calcium and phosphorus determine the direction in which equilibrium conditions are approached in the  $\text{CaO-P-P}_2\text{O}_5\text{-H}_2\text{O}$  systems examined. A solid of atomic ratio Ca/P — 1.33 (octocalcium phosphate) was found to be the least basic of the apatite-like precipitates. It is probably a hydrated infinite two-dimensional complex with sheets held together by water molecules,  $\text{Ca}_8\text{H}(\text{PO}_4)_3 \cdot 3\text{H}_2\text{O}$ . Solids with atomic ratios Ca/P ranging from 1.0 to 1.33 consist of at least two phases: dicalcium phosphate and a solid at least as basic as octocalcium phosphate.

On structural grounds it appears possible that a continuous series of apatite-like solid solutions can exist between octocalcium phosphate and hydroxy- (or fluor-) apatite. In practice, no two preparations with composition lying between octocalcium phosphate and hydroxyapatite are likely to be identical.

The existence of precipitated calcium phosphates more basic than hydroxyapatite, the high loss of ignition of hydroxyapatites and the high fluorine contents of many natural sedimentary phosphates are explained on the hypothesis that thin sheets of apatite structure sorb hydroxyl or other anions where the calciums of the apatite lattice are exposed. Some evidence is obtained of complex ion formation in calcium phosphate solutions in which the atomic ratio Ca/P exceeds 0.5.

8. BREMNER (J. M.). 1950. *Amino-acids in soil*. (Nature, **165**, 367.)

Preliminary results of an examination of the amino-acid composition of soil hydrolysates by the paper chromatography technique.

9. BREMNER (J. M.). 1950. *The amino-acid composition of the protein material in soil*. (Biochem. J., **47**, 538-542.)

The amino-acid composition of acid hydrolysates of ten different soils has been studied by paper partition chromatography.

The following twenty amino-acids were found in every hydrolysate examined; phenylalanine, leucine, isoleucine, valine, alanine, glycine, threonine, serine, aspartic acid, glutamic acid, lysine, arginine, histidine, proline, hydroxyproline,  $\alpha$ -diaminopimelic acid,  $\alpha$ -amino-n-butyric acid,  $\beta$ -alanine,  $\gamma$ -aminobutyric acid and tyrosine. Methionine sulphoxide and glucosamine were found in most of the hydrolysates.

Cystine, methionine and tryptophan could not be detected.

D-Amino-acids were detected in acid hydrolysates of soil, but the small amounts found could have arisen by racemisation during hydrolysis.

No free amino-acids could be detected in any of the soils studied.

The results indicate that the protein materials in different soils are similar in their amino-acid composition.

10. BREMNER (J. M.). 1951. *A review of recent work on soil organic matter. Part 1*. (J. Soil Sci., **2**, 67-82.)

A review of recent investigations on the uronic fraction of soil organic matter and the organic phosphorus and nitrogen of soils.

11. COOKE (G. W.). 1950. *Methods of applying fertilizer to potatoes planted by machines*. (J. Min. Agric., **56**, 571-3.)

The results of experiments comparing different methods of applying fertilizer for potatoes planted by hand in the furrows of ridged land are stated. The implications of these experiments for potatoes planted by machines are discussed. When machines are used to plant from flat land broadcast fertilizer must be applied before planting, a method which may make inefficient use of the fertilizer. Heavy dressings placed in the planting shoe may injure sprouting on light soils, on poor seedbeds and in dry seasons. The most efficient use of fertilizer should be obtained from machines planting on the flat if an attachment places the fertilizer beside and a little below the seed.

12. COOKE (G. W.). 1950. *Fertilizer placement and its application to horticultural crops*. (Worcs. Agric. Chron., **18**, 103-117.)

A general review of the advantage of placement and the results of experiments on arable crops. The applications of special methods of applying fertilizer to horticultural crops are discussed.

13. DEB (B. C.). 1950. *The estimation of free iron oxides in soils and clays and their removal*. (J. Soil Sc., **1**, 212-220.)

The results of the present study clearly demonstrate that no method is quite satisfactory for removing free iron oxides without affecting the crystal structure, but the hydrosulphite method has proved superior to other methods. Its merits may be summarised as follows :

1. Efficient removal of free oxides.
2. Less destructive effect on clay minerals.
3. Easy and quick manipulations.

The study of the base-exchange capacity as affected by different methods of extraction of iron oxides has thrown some light on the difference in stability of various clay minerals towards reducing agents. Thus :

1. Kaolinitic minerals are quite stable towards reducing agents.
2. Hydrous mica or illite is also fairly stable.
3. Montmorillonite containing iron is not stable towards the reducing agents.

14. CROWTHER (E. M.). 1949. *Soil fertility problems in tropical agriculture*. (Commonwealth Bureau of Soil Sci., Tech. Comm. No. 46, 134-142.)

A general review of current problems under the headings :

Soil fertility and crop production.  
Dominant soil processes and nutrient cycles.  
Soil organic matter and crop rotation.  
Livestock and soil fertility.  
Changing agricultural systems.  
Fertilizers.

15. CROWTHER (E. M.). 1950. *Chemicals and crop growth*. (Advancement of Science, **7**, 37-38.)

16. CROWTHER (E. M.). 1949. *Soils and fertilizers*. (J. Roy Agric. Soc. **110**, 135-148.)

17. CROWTHER (E. M.). 1949. *Review of work on nutritional problems in forest nurseries*. (Rothamsted Report, 122-129.)

18. CROWTHER (E. M.). 1950. *The analysis of phosphate fertilizers*. (Chemistry and Industry, No. 48, 763-766); Summary 1949 (*ibid*, No. 27, 808-9).

The current Regulations under the Fertilizer and Feeding Stuffs Act, 1926, are quite inadequate for characterizing some of the newer kinds of fertilizer, many of which contain little or no water-soluble phosphorus but are good sources of available phosphorus in the soil. Some alternative methods of analysis are considered in relation to the complex equilibria involved in the decomposition of the calcium phosphates and to the agricultural value of various kinds of phosphate fertilizers.

119. CROWTHER (E. M.) and GARNER (H. V.). 1950. *Nitrogen fertilizers for sugar beet*. (British Sugar Beet Review, **18**, 101-105.)

The relative values of ammonium sulphate and sodium nitrate for sugar beet were compared in 24 experiments on commercial farms in the years 1945 to 1948. Each nitrogen fertilizer was tested at two rates and on plots with salt and on other plots without salt. Normal dressings of phosphorus and potassium fertilizers were given on all plots.

The average gains in cwt. sugar per acre from ammonium sulphate and sodium nitrate were 6.2 and 10.2 on plots without salt and 7.0 and 7.9 on plots with salt. Where sufficient sodium is supplied from other sources sodium nitrate has only a small advantage over ammonium sulphate, but elsewhere sodium nitrate is far superior to ammonium sulphate because it supplies two important plant nutrients, nitrogen and sodium. Where sodium nitrate is used it is unnecessary to apply additional salt, but where ordinary compound fertilizers are to be used it is always desirable to apply about 3 cwt. of agricultural salt per acre at any convenient time during the winter or early spring.

20. RICKSON (J. B.). 1950. *An improved micro-method for the determination of fluorine based on an examination of the fluoride-fluosilicate equilibrium*. (Analyst, **75**, 84-91.)

A study of the fluoride-fluosilicate equilibrium system indicates that low results in the micro-determination of fluorine by titrating with thorium nitrate, after separation of fluorine from interfering ions by distillation, may be caused by some of the fluorine being present as the fluosilicate ion  $\text{SiF}_6^{--}$ . The fluosilicate ion does not form an un-ionised compound with thorium as does fluoride.

Conditions for titrating fluorine with thorium nitrate so as to avoid this error are described, and the effects of chloride ions and varying pH on the method are discussed.

#### Pedology Department

21. MACEWAN (D. M. C.). 1950. *Solvation of clay minerals in relation to crystal structure: interlamellar adsorption by clay minerals*. (Trans. Fourth Int. Cong. Soil Sci., **1**, 107-109.)

A summarized history of the subject.

22. STEPHEN (I.) and MACEWAN (D. M. C.). 1950. *Swelling Chlorite*. (Geotechnique, **2**, 82-83.)

A note on the material mentioned in last year's report.

23. TALIBUDEEN (O.). 1950. *Interlamellar adsorption of protein monolayers on montmorillonoid clays*. (Nature, **166**, 236.)

Evidence is presented to show the adsorption of polypeptide chains from three proteins in the interlamellar space of oriented flakes of nontmorillonoid clays. One-, two-, and four-layer complexes can thus be formed. The two-layer complex is inert to water and glycerol, and highly resistant to strong acid and alkali.

24. TALIBUDEEN (O.). 1950. *Interlamellar adsorption in artificial layer structures*. (Clay Minerals Bulletin, No. 4, 111-115.)

Conditions for the preparation of a zinc hydroxide with a layer structure are summarized; it is shown that under controlled conditions, this adsorbs different amounts of anionic dyestuffs. At a critical concentration of the latter, these adsorption complexes adsorb non-ionized polar organic molecules in the manner of the montmorillonoid clays. Adsorbed dyestuffs are shown to be displaced by other dyestuffs quantitatively. An explanation for these properties is advanced on the basis of the preferential adsorption of zinc ions.

#### Soil Microbiology Department

25. MEIKLEJOHN (Jane). 1950. *The pure culture isolation of Nitrosomonas europaea*. (Trans. Fourth Int. Cong. Soil Sci., **1**, 195-197.)

*Nitrosomonas europaea* (Winogradsky) has been obtained in pure culture from Rothamsted soil, by modification of Winogradsky's method, as follows:

(1) An enrichment culture was made and the population in it built up; (2) transfers were made on a new liquid medium; (3) the bacteria were removed from the carbonate particles with carbon dioxide; (4) colonies were picked from poured plates on silica gel.

26. MEIKLEJOHN (Jane). 1951. *The effects of glucose on impure cultures of nitrifying bacteria*. (Plant and Soil.) [In the press.]

1. 0.02 M glucose sterilized by filtration delays nitrification.
2. Filtered glucose is not toxic to nitrifying bacteria, so the delay is presumably caused by the rapid growth of the non-nitrifying bacteria.
3. 0.02 M glucose autoclaved in the medium stops nitrification, and is toxic to the nitrifying bacteria.

27. NUTMAN (P. S.). 1950. *Influence of strain and host factors on the efficiency of nitrogen fixation in red clover*. (Proc. Brit. Comm. Specialist Conference in Agriculture, H.M.S.O., London.)

This paper summarises what is at present known of the factors concerned in symbiotic nitrogen fixation which are subject to mutation. On the basis of genetic analysis of host and strain factors a theoretical model is proposed for the essential intracellular reactions involved in determining whether a particular symbiosis is effective or ineffective in nitrogen fixation. It is suggested that these processes are not special reactions concerned only with nitrogen fixation but are also associated with the normal and essential metabolism of hosts and bacteria, and that in an ineffective symbiosis these reactions mutually interfere and lead to the complete breakdown of the metabolism of the bacteria and of the infected plant cell.

28. SINGH (B. N.). 1950. *A culture method for growing small free-living amoebae for the study of their nuclear division*. (Nature, **165**, 65.)

A culture method of growing small free-living amoebae on thin films of non-nutrient agar made on slides as described. After fixation the film is removed, leaving the majority of the amoebae stuck on the glass. As the amoebae are confined to a small area on the slide, it is easy to look for the stages of nuclear division after staining.

29. SKINNER (F. A.). 1950. *Preparation of standardised actinomycete colonies*. (Nature, **166**, 314.)

Description of a method whereby actinomycete colonies of standard size and shape may be obtained on agar media by the use of small open-ended porcelain cylinders to confine the inoculum.

30. SKINNER (F. A.). 1950. *A method for distinguishing between viable spores and mycelial fragments of actinomycetes in soils*. (J. Gen. Microbiol.) [In the press.]

When a suspension of vegetative actinomycete mycelium is shaken violently with sand, the mycelium breaks up into a large number of viable fragments. These fragments are killed if the shaking is prolonged. Spores do not break into smaller viable particles and are killed only with difficulty when shaken under the same conditions. It is, therefore, possible to distinguish suspensions of vegetative mycelium from those of spores by observing the manner in which the viable count varies with the time of shaking. It is not possible to estimate the number of spores and vegetative particles in mixed suspension but the predominating form may be identified. Large numbers of actinomycetes are present in soil samples taken from Broadbalk field, but the evidence obtained from shaking experiments suggested strongly that they were present as free spores.

31. THORNTON (H. G.) and KLECZKOWSKA (Janina). 1950. *Use of antisera to identify nodules produced by the inoculation of legumes in the field*. (Nature, **116**, 1118.)

The method is described in which the effect of inoculum of *Rhizobium trifolii* on Montgomery red clover in field conditions was estimated by application test.

Two effective bacterial strains "Cl.F." and "205" belonging to the serological groups seldom present amongst the *Rhizobium trifolii* were used for inoculum. When nodules were produced the plants were harvested at random from inoculated and uninoculated plots. Bacteria were isolated at

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random from ten nodules and application tests were made. From inoculated plots strain "Cq.F." gave positive response with specific antisera in about 55 per cent, strain 205 in about 15 per cent, and control plots gave about 1 per cent, with antiserum against "Cl.F." and 2 per cent with antiserum against 205 strain.

### Botany Department

32. HUMPHRIES (E. C.). 1950. *The absorption of ions by excised root systems. I. Apparatus and preliminary experiments.* (J. Exp. Bot., 1, 282-300.)

An apparatus is described by means of which the absorption of ions from a complete nutrient solution of constant composition by excised root systems of plants, grown under known nutrient deficiencies, may be measured in standard conditions of aeration and temperature. Results of some preliminary experiments are described.

It was found that the roots readily absorbed the element in which they were deficient, but tended to lose those elements which were already present in normal amounts.

There was almost invariably a loss in fresh weight of the roots after the absorption period and also a loss in dry weight. This loss appears to be complex and is partly attributable to loss of respiratory material.

The addition of 2 per cent sucrose to the solution from which the root systems of phosphorus-deficient barley plants were absorbing increased the nitrogen and phosphorus contents of the roots and maintained the potassium content, while in the absence of sucrose only the phosphorus content increased, but this increase was significantly less than in the presence of sucrose.

It was demonstrated that roots excised from plants growing in soil were capable of absorbing phosphorus or nitrogen—elements in which they were apparently deficient.

The interpretation of data obtained from excised roots is discussed, and it is concluded that excised roots from plants grown in complete nutrient are not likely to behave in the same way as regards absorption as corresponding roots of intact plants, but that roots grown under conditions of deficiency will behave rather similarly whether excised or intact. This fact provides a potential method for diagnosing and evaluating nutrient deficiencies.

The low-salt condition of roots postulated by Hoagland and Broyer is not necessarily the primary requisite for rapid absorption of a particular ion. It is rather that the roots should be deficient in that ion. The roots could be high in other salts.

33. THURSTON (Joan M.). 1950. *A comparison of the growths of wild and of cultivated oats in manganese-deficient soils.* (Ann. App. Biol., 88, 289-302.)

Two species of wild oats, *Avena fatua* and *A. ludoviciana* and two varieties of cultivated oats were grown to maturity in pots of manganese-deficient soil with and without added manganese.

*A. ludoviciana* showed different leaf symptoms of manganese deficiency from *A. fatua* and the cultivated varieties. In other respects wild and cultivated oats were similar in their responses to the level of manganese supply, though differences were observed in the severity of the effects. The relative susceptibility to manganese deficiency of the wild and cultivated oats differed according to the effect considered. The total dry weight at harvest is an integration of all the preceding effects on growth and is therefore presumably the best single criterion for determining susceptibility to manganese deficiency. On the basis of per cent loss of total dry weight at harvest, due to lack of manganese, *A. fatua* is judged less susceptible and *A. ludoviciana* more susceptible than the two cultivated varieties and no distinction can be made between the latter.

The most interesting differences between wild and cultivated oats in response to the level of manganese supply occurred in seed production. Manganese-deficient wild oats showed a smaller reduction in the number of seeds formed but a greater reduction in the size and manganese content of individual seeds than the cultivated varieties.

Manganese deficiency lowered the percentage of viable seeds and the percentage of dormant seeds produced by both *A. fatua* and *A. ludoviciana*.

34. THURSTON (Joan M.). 1950. *The wild oat problem*. (Farming, 4, 332-4.)

The distinguishing characters of *A. fatua* and *A. ludoviciana* are described and possible methods of controlling wild oats are discussed in the light of present knowledge of the biology of the two species.

35. WARINGTON (Katherine). 1950. *The effect of variations in calcium supply, pH value and nitrogen content of nutrient solutions on the response of lettuce and red clover to molybdenum*. (Ann. App. Biol., 37, 617-23.)

The quantity of calcium supplied did not affect the response of the plants to molybdenum, though the calcium requirement was greater in solutions at pH 4.4 than at 6.3. Growth was best in the more acid of a range of solutions from pH 4.2 to 8.2, in spite of a rapid levelling up to a pH between 6 and 7, but with the possible exception of the solution at 8.3, the need for molybdenum was unaffected by the reaction of the medium. When the calcium supply and/or the initial pH value of the solution was varied, the effect of molybdenum was most pronounced in the largest plants. A reduction in the nitrogen supply delayed the response of lettuce to molybdenum, but with both inoculated or uninoculated clover the reverse was true. This difference in behaviour is explained on the assumption that lettuce has a smaller requirement for molybdenum than clover. Five or 10 p.p.m. Mo was of no more benefit than 0.1 p.p.m. at any level of nitrogen supplied, though the liability to damage from toxicity was possibly greater when nitrogen was plentiful.

36. CROOK (E. M.) and WATSON (D. J.). 1951. *Studies on the storage of potatoes, II. The temperature conditions inside potato clamps*. (J. Agric. Sci., 40, 199-226.)

Continuous records of the temperature of potatoes stored in clamps were made in 1942-3 (1 clamp) and in 1943-4 (3 clamps). In the first year, the temperatures at various positions in the clamp coverings were also recorded.

The temperature at the middle of the potato heap showed a drift with time similar to that of mean air temperature. Deviations of mean air temperature from smooth trend, lasting for about a week, had no effect on the temperature of the potatoes; longer-period deviations were reflected in the temperature of the potatoes after a lag of about a week. The difference in weekly mean temperature between potatoes and external air averaged about 1-5°C in 1943-4. In 1942-3 it was greater, increasing to over 20° in April, because bacterial rotting of the potatoes following blight infection increased the rate of heat production and caused the clamp to collapse at the end of April.

In two of the 1943-4 clamps (variety Majestic) the potatoes were exposed to temperatures sufficiently low to cause sweetening for several weeks during February and March. In the third clamp (variety Arran Banner) the temperature of the potatoes never fell below 6°. This difference may have been due to greater heat production by Arran Banner than by Majestic, associated with earlier sprouting.

The temperature in the potatoes tended to fall from the centre of the heap towards the outside, but the temperature gradients across the clamp varied with time and between clamps.

The diurnal temperature wave at the outer surface of the earth cover, caused by absorption of heat from solar radiation during the day and loss of heat during the hours of darkness, penetrated through the earth cover but failed to pass the junction between earth and straw. No diurnal wave was detectable in the straw cover or in the potatoes.

Three effects of wind were distinguished:

1. Wind depressed the temperature of the potatoes at the surface of the heap towards which it was blowing, and raised the temperature at the opposite surface. This occurred in the late stages of storage and was attributed to the earth cover becoming sufficiently dry to permit the passage of external air through it. Southerly winds had a greater effect than northerly winds of equal velocity, presumably because the earth cover dried more rapidly at the south face of the clamp than at the north face. Temperature within the straw cover was affected in the same way as that of the potatoes.



2. The daily temperature range throughout the earth cover and in the air was reduced by wind blowing from any direction.
3. After the earth cover was removed from a clamp, in April, 1944, wind greatly increased the diurnal temperature fluctuation at the surface of the potatoes on the side of the clamp towards which the wind was blowing, and suppressed it on the opposite side.

It is concluded that the chief barrier to the penetration of external temperature fluctuation lies at the junction of the earth and straw covers, and that the thickness of the coverings is therefore not very critical.

In general, clamp storage in eastern England provides temperature conditions reasonably close to the optimum only during the months from November to April in winters free from prolonged frosts.

37. CROOK (E. M.) and WATSON (D. J.). 1951. *Studies on the storage of potatoes, III. The composition of the atmosphere in a potato clamp.* (J. Agric. Sci., **40**, 227-32.)

The CO<sub>2</sub> concentration in the atmosphere of a potato clamp varied between 0.06 and 0.86 per cent. The sum of CO<sub>2</sub> and oxygen concentrations remained approximately constant at 21 per cent. The CO<sub>2</sub> concentration increased with time from December to April. This was attributed to increase in the rate of respiration of the potatoes caused by rise of temperature. Wind blowing in the direction normal to the face of the clamp reduced the CO<sub>2</sub> concentration, presumably by causing external air to flow through the clamp coverings. A multiple regression of CO<sub>2</sub> concentration on temperature of the potatoes at the time of sampling, and on the mean component of wind velocity normal to the clamp face estimated over a period of 3 hours before the time of sampling, accounted for 64 per cent of the variance between sampling occasions.

Unsaturated compounds were detected in the clamp atmosphere by absorption in bromine; the concentration of these, expressed as ethylene varied between 0.004 and 0.025 per cent.

The magnitude of CO<sub>2</sub> accumulation and oxygen depletion in the clamp atmosphere was too small to produce effects of practical importance on the storage of the potatoes. If the unsaturated compounds were ethylene, the concentration present was sufficient to cause appreciable retardation of sprouting.

38. WATSON (M. A.) and WATSON (D. J.). 1951. *The effect of infection with beet yellows and beet mosaic viruses on the carbohydrate content of sugar beet leaves and on translocation.* (Ann. App. Biol., **38**, 276-288.)

The loss of total carbohydrate (sugars and starch) per cent of residual dry matter (dry matter less total carbohydrate) during a period of darkness from leaves of sugar beet plants infected with yellows virus was as great as that from leaves of healthy plants. The conclusion of previous workers, based on the results of the Sachs iodine test for starch and the occurrence of phloem gummosis in infected plants, that starch accumulates in infected leaves because translocation is prevented by blockage of the sieve-tubes, is therefore incorrect.

Older leaves of infected plants had a higher content of reducing sugars and sucrose, and usually but not invariably of starch, both at the beginning and end of the dark period, than comparable leaves of healthy plants. By far the greater part of the increase was in reducing sugars. In leaves taken in late September from infected plants growing in the field, 20 per cent or more, of the total dry matter, was present as reducing sugars. The reducing sugars in both healthy and yellows-infected leaves were shown by paper chromatography to be glucose and fructose in approximately equal amounts.

The carbohydrate content of sugar beet leaves was little affected by infection with beet-mosaic virus.

Yellows-infected leaves had a lower water content per cent of fresh weight than healthy leaves. This was accounted for by the higher carbohydrate content of infected leaves, for the ratio of water: residual dry matter was not affected by infection or was slightly reduced. This implies that hydration was independent of carbohydrate content.

### Statistics Department

39. BOYD (D. A.) and DYKE (G. V.). 1950. *Maincrop potato growing in England and Wales*. (N.A.A.S. Quarterly Review, No. 10, 47-57.)

The Survey of Maincrop Potatoes, initiated in 1948 by the Agricultural Improvement Council, provides detailed data on commercial potato growing methods in England and Wales, together with estimates of yield based on sample liftings. It is shown that official estimates of yield in 1948 and 1949 were one and three-quarter tons per acre below the sample figure.

Examination of the survey data together with summaries of results of experiments shows that growers' practice is mainly satisfactory but improvements in total production might be achieved by earlier planting and better use of farmyard manure.

The need is stressed for further experiments comparing first, early and late planting and second, certified and once-grown seed.

40. GRUNDY (P. M.). 1951. *A general technique for the analysis of experiments with incorrectly treated plots*. (J. R. Statist. Soc.) [In the press.]

Occasionally in field experiments the wrong treatment is accidentally applied to one or more plots, and as a result difficulties occur in the statistical analysis. The special methods hitherto devised for such cases are of restricted scope. This paper gives a flexible technique for dealing with such disturbances in a variety of different experimental designs. The new method is based on the formulation of a problem which may be regarded as a generalization of both the disturbed and undisturbed designs. The analysis falls into two stages, of which the first (the solution of the generalized problem) is formally similar to a missing-plot analysis. In the second stage, the necessary constraints are applied to the estimates obtained from the first stage. The principles underlying this method are discussed, and different aspects of the technique illustrated by examples; one of these is the 1947 Rothamsted experiment on the effects of organic manures on potatoes.

41. HEALY (M. J. R.). 1950. *The planning of probit assays*. (Biometrics, 6, 424-431.)

Graphs are presented from which the number of test subjects necessary to achieve a desired degree of precision in a  $2 \times 3$ -point probit assay may be determined.

42. HEALY (M. J. R.). 1951. *Statistical appendix to paper by F. M. P. Eikstein, P. Krohn and S. Zuckerman, the potency of different oestrogens in monkeys*. (J. Endocrinol.) [In the press.]

The main paper described a large experiment in the induction of artificial oestrus in monkeys by means of synthetic oestrogens, the results of which showed a high degree of non-orthogonality and other irregular features. The appendix describes the methods of analysis adopted, and discusses some points that arise in the handling of this kind of data.

43. YATES (F.). 1950. *The place of statistics in the study of growth and form*. [A discussion on the measurement of growth and form. Under the leadership of S. Zuckerman, F.R.S.] (Proc. Roy. Soc., Series B, 137, 479-488.)

This paper discusses the functions of statistics in the study of growth and form. Much of the statistical work involved in such study consists of the fitting of some mathematical relation to the observed data. The various objectives of such fitting and the limitations to which deductions based on the fitting are subject are discussed. The statistical processes that are appropriate to the handling of simultaneous measurements on a number of characteristics are also briefly discussed.

44. YATES (F.). 1951. *Manuring for higher yields. Contributions to symposium: Four thousand million mouths: scientific humanism and the shadow of world hunger*, edited by F. le Gros Clark and N. Pirie. (Oxford University Press.) [In the press.]

This paper discusses the part played by scientific manuring in the increase of crop yield and the problems that arise in the planning of the agriculture of

a region so as to lead to the maximum production of human food. The experience of Great Britain in the use of fertilizers and in agricultural planning is taken as an illustrative example.

45. YATES (F.). 1951. *The influence of Statistical Methods for Research Workers on the development of the science of statistics*. (J. Amer. Stat. Assoc.) [In the press.]

R. A. Fisher's *Statistical Methods for Research Workers* was first published 25 years ago. The book is of particular interest to Rothamsted since it was written by Fisher after five years' work at the Station and embodies the results of Fisher's researches during his early years there. The paper contains a critical review of the influence of the book on the development of the science of statistics and experimental design.

#### CORRESPONDENCE AND REVIEWS

46. HEALY (M. J. R.) and LEECH (F. B.). 1950. *Statistical analysis of results for successive tests on the same organism*. (Letter to Nature, **166**, 319.)
47. YATES (F.). 1950. *Review of The theory of inbreeding*, by R. A. Fisher. (Eugenics Review, **42**, 158.)
48. YATES (F.). 1951. *Review of Experimental designs*, by William G. Cochran and Gertrude M. Cox. (Science Progress.) [In the press.]

#### REPORTS

- 48a. LORD (Rowena). 1950. *Survey of Fertilizer Practice Report : The Culm Measures, Devon*.
- 48b. POULTON (Emily P.). 1950. *Survey of Fertilizer Practice Report : The Chalklands of Berkshire*.
49. REES (D. H.). 1950. *Experiments on the feeding of sugar beet and fodder beet to pigs*. (Memorandum prepared for the Animal Experiments Sub-Committee of the Agricultural Improvement Council.)
50. YATES (F.). 1950. *Operational research*. (Prepared for the 4th Session of the United Nations Sub-Commission on Statistical Sampling.)

#### Plant Pathology Department

##### GENERAL PAPERS

51. BAWDEN (F. C.). 1950. *Interference phenomena with plant and bacterial viruses*. (In *Viruses 1950*, edited by M. Delbruck, Calif. Inst. Technology, pp. 30-34.)
52. BAWDEN (F. C.). 1950. *Some properties of the tobacco necrosis viruses*. (Seventh Int. Bot. Cong.)
53. BAWDEN (F. C.). 1951. *The multiplication of viruses*. (Sci. Progr. **39**, 1-12.)
54. BAWDEN (F. C.) and PIRIE (N. W.). 1950. *The varieties of macromolecules in extracts from virus-infected plants*. (In *Viruses 1950*, edited by M. Delbruck, Calif. Inst. Technology, pp. 35-39.)
55. GLYNNE (Mary D.). 1950. *Factors affecting the incidence of eyespot, Cercospora herpotrichoides Fron. on cereals*. (Seventh Int. Bot. Cong.)
56. GLYNNE (Mary D.). 1950. *Close cereal cropping. Effect of cultural treatments of wheat on eyespot, lodging, take-all and weeds*. (Agriculture, **56**, 510-514.)
57. GREGORY (P. H.). 1950. *Factors controlling plant disease gradients*. (Seventh Int. Bot. Cong.)

58. HULL (R.). 1950. *Some factors affecting the incidence of yellows virus in sugar beet in Great Britain.* (Seventh Int. Bot. Cong.)
59. HULL (R.). 1950. *Virus yellows in sugar beet.* (Farming, 4, 72-77.)
60. HULL (R.). 1950. *Virus yellows; need for healthy stecklings.* (British Sugar Beet Review, 18, 107-111.)
61. WATSON (Marion A.). 1950. *Behaviour of persistent and non-persistent aphid-transmitted plant viruses.* (Seventh Int. Bot. Cong.)

#### RESEARCH PAPERS

62. BAWDEN (F. C.) and NIXON (H. L.). 1951. *The application of electron microscopy to the study of plant viruses in unpurified plant extracts.* (J. Gen. Microbiol, 5, 104-109.)

Rods of variable lengths occurred in sap from plants infected with tobacco mosaic, cucumber mosaic, potato X, potato Y, henbane mosaic, tobacco etch, and cabbage blackring-spot viruses; the first two were about 15 m $\mu$  wide and appeared rigid, the others were about 10 m $\mu$  wide and apparently flexible. Sap from plants infected with tomato bushy stunt, tobacco ring-spot and two tobacco necrosis viruses contained spherical particles about 26 m $\mu$  in diameter; two particles, one about 18 m $\mu$  and the other about 37 m $\mu$  in diameter, occurred in sap from plants infected with a third tobacco necrosis virus. No specific particles were identified in sap from plants infected with tomato spotted wilt, potato leaf roll, cauliflower mosaic, tomato aspermy, sugar beet mosaic and sugar beet yellows viruses. Serologically related strains of any one virus were morphologically indistinguishable, but this has little diagnostic value because so also were some unrelated viruses.

63. BHARGAVA (K. S.). 1951. *Some properties of four strains of cucumber mosaic virus.* (Ann. App. Biol., 38.)

Different strains of cucumber mosaic virus differ in their host range, symptoms caused, virulence towards different plants, transmissibility by aphids, dilution end-point and thermal inactivation point.

There are seasonal variations in the susceptibility of some host species; French bean is apparently immune during summer but during winter produces countable local lesions suitable for quantitative assays.

Different host species differ in the ease with which cucumber mosaic virus is transmitted to and from them; systemic infection in beet rarely occurred unless the virus was introduced into young tissues. Inhibitors of infectivity in sap of sugar beet and *Phytolacca* sp. make mechanical transmission from these to other hosts difficult; the inhibitors interfere less with the infection of hosts in which they occur than with infection of tobacco.

Cucumber mosaic virus has a low temperature coefficient of thermal inactivation and much infectivity is destroyed by heating at temperatures below the thermal inactivation point.

*Myzus persicae* (Sulz.) is a more efficient vector than *Myzus ornatus* (Laing), which is more efficient than *Macrosiphum euphorbiae* (Thomas); although individual aphids could cause more than one infection, most cease to be infective in feeding periods of from one to five minutes.

64. BROADBENT (L.). 1950. *The microclimate of the potato crop.* (Q. J. Roy. Met. Soc., 76, 439-454.)

Shade temperatures and humidities in a standard screen and at an arbitrary level of 15 cm in potato crops were continuously recorded during three summers, 1947-49.

In dry sunny periods:

1. the maximum temperature in the crop was from 0° to 13°F higher than in the screen, and over a period of eleven weeks in 1947 averaged 6°F higher;
2. the crop minimum was about 2°F lower than in the screen;
3. over a period of five weeks in 1949 the average daily mean temperature in the crop was 2.2°F higher than in the screen, and
4. the average daily temperature range was 8°F greater than in the screen.

Wind, wet soil and cloudy weather greatly reduced these contrasts; occasionally the crop minimum was higher than the screen minimum.

By day, humidity was higher in the crop than in the screen, the average difference at the minima being 5 per cent in relative humidity, and 7°F in dew point. By night, the dew point in the crop was, on average, 2°F lower than in the screen, corresponding to the observed difference in mean minimum air temperatures.

During 1948 and 1949, more precise discontinuous records were taken of temperature, humidity and wind speed in and above potato crops with different densities of foliage in a variety of weather conditions. Temperature and humidity were measured at 10, 20 or 30, and 60 cm; wind at 20, 30 and 200 cm above ground level. In the crop there was only a slight temperature gradient in the early morning and throughout cloudy days, but during sunny days gradients were produced, depending on crop density; it was hottest at 10 cm in an open crop, at 30 cm in a dense crop; in both it was usually coolest at 60 cm when the soil was dry, but over wet soil the lowest temperature was found at 10 cm. Except on cloudy days, temperature inversion took place before sunset whatever the foliage density or moistness of the soil.

Humidity (dew point) was usually greatest at 10 cm, but in a dense crop over dry soil water vapour transpired from the leaves often caused the air at 30 cm to be more humid than that at 10 cm.

Wind affected both temperature and humidity by increasing lapse rates and causing rapid fluctuations within the crop, particularly of humidity. Changes of wind speed within the crop took place every few seconds, the amplitude of the fluctuations depending on the speed of the wind above the crop.

65. BROADBENT (L.), CHAUDHURI (R. P.) and KAPICA (L.). 1950. *The spread of virus diseases to single potato plants by winged aphids*. (Ann. App. Biol., **37**, 355-362.)

Young potato plants in pots exposed in the open near plots of potatoes for limited periods at intervals during the summer, became infested with large numbers of winged aphids only during warm, calm and dry weather. Although visited by aphids during May and June, when much of the spread of viruses occurred in nearby potato crops, few of the potted plants became infected. Most potted plants became infected in July when alate aphids were leaving neighbouring potato crops. Widely different proportions of the exposed plants became infected in different years; in two of the three years, many more plants were infected with virus Y than with leaf roll virus.

66. BROADBENT (L.), GREGORY (P. H.) and TINSLEY (T. W.). 1950. *Roguing potato crops for virus diseases*. (Ann. App. Biol., **37**, 640-650.)

Removing virus-infected plants from plots of Majestic potatoes at Rothamsted on 2nd July did not reduce the spread of leaf roll but reduced rugose mosaic (potato virus Y) to about one-fifth of that in plots rogued on 21st July or left unrogued. Roguing Arran Pilot potatoes on 16th June, or 2nd July reduced leaf roll to five-sixths of that in unrogued plots; roguing on 16th June reduced rugose mosaic to about half that in plots rogued on 2nd July, and about a quarter of that in unrogued plots. Lifting Arran Pilot potatoes in mid-August reduced virus diseases to about two-thirds.

Roguing flattened the gradient (decrease in percentage plants diseased with increasing distance from the source of infection) with rugose mosaic, but had little effect with leaf roll. Evidently any plants prevented by roguing from contracting virus Y were near the initially infected plants.

In 1948 Majestic and King Edward potatoes at three places were rogued during 22nd-24th June and tubers were dug during 28th-30th July and again at the end of the season. Leaf roll spread more in Majestic than in King Edward, and rugose mosaic spread more in King Edward. Roguing reduced the spread of both by about one-fifth at Rothamsted, but had no effect at Sutton Bonington. At Bretton, in the Derbyshire hills, roguing had no effect on leaf roll, but prevented the spread of rugose mosaic.

The small benefit occasionally achieved by roguing in the ware-growing districts of England does not make the practice economically worth while.

67. BROADBENT (L.) and TINSLEY (T. W.). 1951. *Experiments on the colonisation of potato plants by apterous and alate aphids in relation to the spread of virus diseases*. (Ann. App. Biol., **38**.)

Batches of potato plants in pots were placed in the field for limited periods among plants infected with potato virus Y and leaf roll virus. Some

of the potted plants were surrounded by sticky boards which prevented apterous aphids from reaching them. Almost as many plants within the boards as without became infected, indicating that most of the spread of virus was by winged aphids.

Apterae were probably responsible for spreading the viruses throughout a hill after one or more stems were infected. They may carry infection to neighbouring plants, but most of these will have been infected already by alate.

The number of plants contracting infection was unaffected by watering.

68. GLYNNE (Mary D.). 1950. *Sharp eyespot as a severe disease of oats*. (Nature, **166**, 232.)

Sharp eyespot caused by *Corticium (Rhizoctonia) Solani* is known as a common but not severe disease of wheat. It is here recorded as causing a severe disease in a crop of oats. Isolates from wheat, inoculated into wheat, barley, oats and rye in sand culture, produced lesions on all four cereals, but oats and rye were much more severely affected than wheat and barley, the fungus penetrating more deeply into their tissues and killing about half the inoculated seedlings.

69. GREGORY (P. H.). 1950. *Deposition of air-borne particles on trap surfaces*. (Nature, **166**, 487-488.)

Examples are given from experiments both in a wind tunnel and in the open air of the efficiency with which sticky traps in the form of vertical cylinders and plates remove spores of *Lycopodium* and *Lycoperdon* from wind sweeping their surface. Efficiency is below 1 per cent for the small spores of *Lycoperdon* under the conditions tested. Tests with horizontal traps of the type employed in pollen studies have shown that deposition at higher wind speeds tested must result mainly from turbulence and not as previously assumed from sedimentation under gravity. For example, with *Lycopodium* in a wind of approximately 9 m./sec. the same number of spores may be deposited on the lower surface as on the upper surface of a horizontal slide.

70. GREGORY (P. H.) and NIXON (H. L.). 1950. *Electron micrographs of spores of some British Gasteromycetes*. (Trans. Brit. Mycol. Soc., **33**, 359-361.)

Spores of some British Gasteromycetes have been examined with the electron microscope. The increased resolving power and great depth of focus enable details of the surface ornamentation to be studied, but the low penetrating power of the 50 kV. electrons used does not permit any internal structures to be seen. The spores of some species which were previously described as smooth are shown to be warted, and the warts on all species examined appear to conform to the same basic pattern. This consists of a low truncated cone having an angle of 45-70° capped by a much flatter cone, the shape of which varies among the different species. To account for the formation and shape of the warts, and also for the presence of circular discs about 0.2 μ diameter, sometimes observed in mounts from immature specimens, it is suggested that, during the disintegration of the gleba, the spores are coated with a gelatinous film which shrinks and cracks while drying.

71. KASSANIS (B.). 1950. *Heat inactivation of leaf-roll virus in potato tubers*. (Ann. App. Biol., **37**, 339-341.)

When potato tubers were stored at 37.5°C. in a humid atmosphere, some lost their germinating power after 20 days but others survived up to 40 days. All tubers infected with leaf-roll virus that survived 25 days at this temperature produced healthy plants. Similar treatments up to 40 days did not free tubers from potato viruses X and Y.

72. KLECZKOWSKI (A.). 1950. *Restoration of the ability of some heated antisera to flocculate specifically their antigens*. (Brit. J. Exp. Path., **31**, 145-154.)

The ability of some antisera to flocculate, i.e. precipitate or agglutinate, their antigens, which is lost by heating, can be restored by incubation with trypsin. The restoration occurs because complexes, formed between antibodies and other serum proteins during the initial stages of heat denaturation, are disaggregated. Trypsin also causes some changes in the molecules of heat-denatured antibodies, probably reducing their size. The changed antibodies still combine specifically with their antigens, but whether or not the

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combination leads to flocculation depends on the character of the antigen. Tobacco mosaic virus, tomato bushy stunt virus and a strain of clover nodule bacteria were flocculated by trypsin-treated, heat-denatured antibodies, but horse serum albumin was not.

73. KLECZKOWSKI (A.) and KLECZKOWSKI (Janina). 1951. *Ability of single phage particles to form plaques and to multiply in liquid cultures.* (J. Gen. Microbiol., **5**, 346-356.)

The results of testing a bacteriophage to a strain of clover nodule bacteria using young (1 day) and old (5 days) bacterial cultures both fit to the hypothesis that phage multiplication can be initiated by single phage particles. As the same phage preparations gave more plaques on solid media and higher proportions of liquid cultures in which phage multiplication could be detected with young than with old bacterial cultures, the fit to the hypothesis is not evidence that every single phage particle will multiply. It may be so when young bacterial cultures are used, although there is no positive evidence for it. With older bacterial cultures definitely only a proportion of viable phage particles succeed in starting phage multiplication, the proportion decreasing with the increasing age of bacterial cultures used for testing.

74. ROBERTS (Florence M. L.). 1950. *The infection of plants by viruses through roots.* (Ann. App. Biol., **37**, 385-396.)

Roots of young tomato plants became infected when inoculated with tomato bushy stunt, tobacco mosaic, and potato X viruses. Root infections also occurred when these viruses were added to soil or culture solutions in which plants were growing.

The viruses were sometimes localized around their initial entry points in roots; sometimes they invaded the root system but not the shoots, and sometimes they produced full systemic infection of roots and shoots. In some experiments, but not all, systemic infections were more frequent when the upper tap root or superficial roots were inoculated than when fibrous roots were inoculated.

In both tomato and potato, virus X spread from diseased to healthy plants sharing the same culture solution, if their roots were in contact, but not otherwise. Infection of the roots of potato plants by inoculation, produced only one plant with virus-infected haulms, although several had infected tubers.

#### Biochemistry Department

75. BAWDEN (F. C.) and PIRIE (N. W.). 1950. *Some factors affecting the activation of virus preparations made from tobacco leaves infected with a tobacco necrosis virus.* (J. Gen. Microbiol., **4**, 464-481.)

Preparations of the Rothamsted tobacco necrosis virus were made by the ultracentrifugation of sap from infected tobacco leaves after a preliminary concentration by freezing. Not all the anomalous nucleoprotein in these preparations was infective, and the products were fractionated by differential ultracentrifugation at lower speeds and by precipitation at pH 4 in the presence of sedimentable protein from uninfected leaves. The more readily sedimentable and precipitable material carries with it most infectivity, whereas the other has the greater serological activity.

Preparations made quickly from freshly expressed sap are less infective than those made from sap that has been frozen or allowed to age for a few days. The extent of the activation produced by these treatments depends on the physiological condition of the infected leaves.

As much virus can be extracted from the leaf residues as occurs in the sap. The infectivity of this residual virus depends on the medium used for its extraction.

It is suggested that much of the infectivity of this virus in sap is acquired during or after extraction from the leaf, but the relationship between the particles with different sizes and properties remains uncertain.

76. BAWDEN (F. C.) and PIRIE (N. W.). 1950. *Some effects of freezing in the leaf, and of citrate in vitro, on the infectivity of a tobacco necrosis virus.* (J. Gen. Microbiol., **4**, 482-492.)

Preparations of the Rothamsted tobacco necrosis virus made from tobacco leaves that have been frozen while intact are less infective than

preparations made from unfrozen leaves. Freezing minced leaves or expressed sap does not destroy infectivity. The suggestion is made that much virus in the intact leaf becomes infective only by means of a mechanism that is set in action by mincing and is disordered by freezing.

The infectivity, but not the serological activity, of the virus is lost on exposure to 0.02-0.01 M neutral citrate; the extent of this inactivation is influenced by the temperature, pH, duration of exposure, concentration of virus and presence of salts and other substances. Similar processes could influence the infectivity of the virus in sap and may do so in the leaf.

77. GRÉGOIRE (J.). 1950. *Action de la soude N/30 sur le virus de la mosaïque du tabac et sur l'acide nucléique du virus ainsi libéré. 1. Mise en évidence d'un facteur accélérant la perte de précipitabilité de l'acide nucléique et la formation de produits diffusibles.* (Bull. Soc. Chim. Biol., **32**, 359.)

Nucleic acid can be made from tobacco mosaic virus if the linkage between nucleic acid and protein is broken by exposure for a few minutes at room temperature to N/30 NaOH followed by removal of the denatured protein at pH 5.2 and precipitation of the nucleic acid by strong acid. The nucleic acid, when isolated, is stable for many hours in N/30 NaOH, but if it is left in this environment in the presence of the protein split products it loses its acid precipitability. Evidence is presented that this is due to a depolymerisation of the nucleic acid catalysed by protein derivatives of high molecular weight.

78. HOLDEN (Margaret). 1950. *A study of enzymes that can break down tobacco leaf components. 3. Fungal polygalacturonase on leaf fibre.* (Biochem. J., **47**, 415-420.)

Tobacco leaf fibre incubated at pH 4.5 several times with fresh lots of purified polygalacturonase loses about half of the polyuronide. Milling the fibre increases the rate of release of carbohydrate from fibre with PG and also increases slightly the total amount liberated. Decalcification of fibre by cationic exchange with concentrated salt solutions, and by acid extraction, increases the rate of liberation of carbohydrate by PG, and up to 95 per cent of the polyuronide present is released. NaCl in concentrations >0.05 M inhibits PG action on fibre, but lower concentrations >0.01-M activate. CaCl<sub>2</sub> is inhibitory except in concentrations below about 0.001-M when using decalcified fibre.

79. HOLDEN (Margaret). 1950. *A study of enzymes that can break down tobacco leaf components. 5. Unfractionated fungal enzymes.* (Biochem. J., **47**, 426-431.)

The effects on tobacco leaf fibre of some enzyme preparations of fungal origin have been investigated and compared with those of snail digestive juice. The enzymic activities of the preparations on a number of polysaccharides; cellulose, pectic acid, starch and inulin, and on haemoglobin and gelatin were determined.

80. HOLDEN (Margaret), PIRIE (N. W.) and TRACEY (M. V.). 1950. *A study of enzymes that can break down tobacco leaf components. 1. Digestive juice of helix on leaf fibre.* (Biochem. J., **47**, 399-407.)

The effect of *Helix* digestive juice polysaccharidases on tobacco leaf fibre has been investigated. Various pretreatments of the fibre modify the action of these enzymes. 90 per cent of the carbohydrate of the fibre can be brought into solution. The nature of the insoluble residue is discussed. Cellulase and polygalacturonase are principally concerned in this digestion. The action of the latter is favoured by preliminary decalcification of the fibre. Snail digestive juice has little action on the green "chloroplast" fraction of sap sediment. The merits of disintegrating leaves enzymically are considered, but the fact that release by a specific enzyme does not give unequivocal evidence about the original linkage of a substance is recognised.

81. HOLDEN (Margaret) and TRACEY (M. V.). 1950. *A study of enzymes that can break down tobacco leaf components. 2. Digestive juice of Helix on defined substrates.* (Biochem. J., **47**, 407-414.)

The action of snail digestive juice on cellulose (cellophane) and pectic acid has been investigated. A number of polysaccharides and polysaccharide



derivatives have been tested as substrates for snail digestive juice. Hyaluronic acid, alginic acid, a dextran from *Betacoccus arabinosaceus*, "galactogen" from *H. asperoa* and nitrocellulose were not affected, while irisin, yeast glucan, a levan from grass, a bacterial levan, methylcellulose, methylethylcellulose, and carboxymethylcellulose were.

A sensitive method for the detection of cellulase has been developed. The reduction in viscosity of a water-soluble cellulose derivative is used as an index of cellulase activity.

Sodium carboxymethylcellulose is split enzymically to an extent corresponding with the breaking of glycoside links between unsubstituted residues. Methylethylcellulose is split to an extent corresponding with the breaking of glycoside links between residues one of which is unsubstituted.

82. HOLDEN (Margaret) and TRACEY (M. V.). 1950. *A study of enzymes that can break down tobacco leaf components. 4. Mammalian pancreatic and Salivary enzymes.* (Biochem. J., **47**, 421-425.)

All starch may be removed from tobacco leaf fibre by incubation with salivary amylase. All starch and about 80 per cent of the total nitrogen can be removed from tobacco leaf fibre by incubation with commercial trypsin. Incubation with commercial trypsin leads to a loss of  $\text{CHCl}_3$  soluble material parallel with the loss of dry matter. Figures are given for the composition of the particulate matter in crude saps.

83. PIRIE (N. W.). 1950. *A biochemical approach to viruses.* (Nature, **166**, 495-496.)

84. PIRIE (N. W.). 1950. *The isolation from normal tobacco leaves nucleoprotein with some similarity to plant viruses.* (Biochem. J., **47**, 614-625.)

A nucleoprotein has been prepared from the sap of young uninfected tobacco leaves by ultracentrifugation. The yield varies from 3 g./l. with the sap of immature leaves to 0.1 g./l. or less with large mature leaves, or with sap that has been allowed to age before processing. The nucleoprotein is unstable *in vitro* and autolyses in a few hours at 37° yielding denatured protein and either nucleotides or nucleosides depending on the duration of hydrolysis. The denatured protein still retains some of the enzymes that occur in leaf sap and different preparations have been compared using metaphosphate, glycerophosphate, adenosine triphosphate and yeast nucleic acid as substrates. Reasons are given for thinking that, although it bears some resemblance to them, the nucleoprotein cannot usefully be regarded as a precursor of the plant viruses.

85. TRACEY (M. V.). 1950. *Proteins.* (Annual Reports of the Chemical Society for 1949, **46**, 211-228.)

A review concerned with advances in protein chemistry from 1937 to 1949. In the space available only two topics are discussed in detail—the present state of our knowledge of the organic chemistry of  $\beta$ -lactoglobulin and the organic chemistry of synthetic polypeptides.

86. TRACEY (M. V.). 1950. *Cellulase from leaves and roots of tobacco.* (Biochem. J., **47**, 431-433.)

An enzyme that can depolymerise sodium carboxymethylcellulose, and split reprecipitated cellulose has been found in tobacco plants. The enzyme, which is similar in properties to animal and fungal cellulases, is present in very low concentrations. It is suggested that this may be explained by its localisation in cells in which reconstruction of the thin primary cell wall is occurring as a concomitant of cell growth.

87. TRACEY (M. V.). 1950. *A colorimetric method for the determination of pentoses in the presence of hexoses and uronic acids* (Biochem. J., **47**, 433-436.)

A method for the colorimetric estimation of pentoses in the presence of large amounts of other sugars is described. It is suitable for the determination of 10–100  $\mu\text{g}$ . of xylose. Glucose interference was found to be about 2 per cent and galactose and galacturonic acid interference about 5 per cent. Interference by other sugars tested was less than 1 per cent. The effect of varying conditions on the specificity and sensitivity of the reaction was determined and optimal conditions are described. Increased temperature,

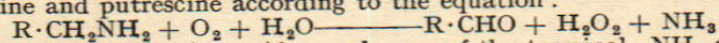
time of development and concentration of aniline all affect colour development by the sugars examined, but not equally. The addition of oxalic acid increases the specificity of the test.

88. KENTEN (R. H.) and MANN (P. J. G.). 1951. *The oxidation of amines by extracts of pea seedlings*. (Biochem. J., **46**, 67-73.)

A colorimetric test, based on the oxidation of added  $Mn^{++}$  to  $Mn^{+++}$  is described for the detection of hydrogen peroxide in plant extracts. By means of this test evidence has been obtained that hydrogen peroxide is produced by enzyme systems present in extracts of many higher plants.

An enzyme, plant amine oxidase, catalysing the oxidation of amines is present in extracts of pea seedlings. With the growth condition used plant amine oxidase appears in pea seedlings, mainly in the cotyledons, 3-4 days after germination, and is maximal over the period 7-18 days. Only slight activity is found in the adult plant. Of the other plants tested only lupin seedlings have so far been shown to have comparable activity. Both mono- and di-amines are attacked by the extracts. It is not yet known whether this is due to the presence of specific mono- and di-amine oxidases. Diamines, in particular putrescine and cadaverine, are more readily attacked than mono-amines. Of the mono-amines tested  $\beta$ -phenylethylamine and di- $\beta$ -phenylethylamine are most readily attacked.

The plant amine oxidase catalyses the oxidative deamination of  $\beta$ -phenylethylamine and putrescine according to the equation:



As with animal diamine oxidase only one of the terminal  $-NH_2$  groups is attacked. The phenylacetaldehyde formed by the action of plant amine oxidase on  $\beta$ -phenylethylamine was oxidised by an aldehyde oxidase present in the preparation used. It is suggested that 3-indolylacetic acid may be formed by the successive action of plant amine oxidase and of the aldehyde oxidase on tryptamine.

89. PIRIE (N. W.). 1951. *The circumvention of waste*. (In: *Four thousand million mouths*. Oxford University Press.) [In the press.]

#### Nematology Department

90. FENWICK (D. W.). 1951. *Investigations on the emergence of larvae from cysts of the potato root eelworm Heterodera rostochiensis. IV. Physical conditions and their influence on larval emergence in the laboratory*. (J. Helminth., **25**.) [In the press.]

The influence of preconditioning, temperature, volume of diffusate per cyst, pH, degree of dilution and presence or absence of light on the hatching of the potato root eelworm in root diffusate, is investigated. The effect of these factors on hatchability, mean hatching time and on the slope of the probit line are described in detail and suitable conditions for the conduct of hatching tests are suggested.

91. FENWICK (D. W.). 1951. *Investigations on the emergence of larvae from cysts of the potato root eelworm Heterodera rostochiensis. V. A shortened method for the conduct of hatching tests*. (J. Helminth., **25**.) [In the press.]

A method of estimating the three parameters of the hatching curve without carrying on a hatching test to completion is described. Use is made of the fact that the hatching curve plotted against log-time is a symmetrical sigmoid and a geometrical construction is given for estimating the point of inflection. The number of larvae emerging at this point is an estimate of 50 per cent of the final total hatch. The plotting of a complete probit line is thus possible with a saving of 70 per cent in time.

92. FENWICK (D. W.). 1951. *The effect of temperature on the development of the potato root eelworm Heterodera rostochiensis*. (Ann. App. Biol.) [In the press.]

Experiments are described on the effect of temperature on the development of *H. rostochiensis*. Soil temperatures above 20°C. appear to be unfavourable, influencing the penetration of larvae into the potato root as well as development within the root. The temperature range of the parasite is compared with that of *H. marioni* and the possible relationship to the geographical distribution peculiar to each parasite is discussed.

93. FENWICK (D. W.). *A new modification of the MacMaster slide for use in potato root eelworm investigations.* (J. Helminth.) [In the press.]

A new modification of the McMaster slide is described. This version is more stable than any previous type and up to six counting cells can be accommodated in one unit; instructions are given for making such a slide out of sheet perspex.

94. FENWICK (D. W.) and REID (Elizabeth). *A rapid method for estimating the density of white cysts of Heterodera rostochiensis on potato roots.* (Nature.) [In the press.]

A new method of estimating the density of white cyst populations on potato roots to a known degree of accuracy is described.

95. GOODEY (J. Basil). 1950. *Potato-tuber eelworm and iris bulbs.* (Nature, **165**, 495.)

A letter to the effect that *Ditylenchus destructor* is responsible for the eelworm disease of bulbous iris.

96. GOODEY (J. Basil). *Observations on the attack by stem eelworm on strawberry.* [In the press.]

The history of disease in strawberry caused by *Ditylenchus dipsaci* is summarised and observations made on recent cases in Britain are recorded. Experimental work has shown that populations of *D. dipsaci* from teasel, oats, onion, red clover, narcissus and rye will all infest most of the varieties cultivated to-day. The symptoms manifested by the plant and the methods of attack by the parasite are described.

97. GOODEY (T.). 1949. *Plant parasitic nematodes: a brief survey and some present day trends.* (13th Congrès International de Zoologie Paris, 21-27 July, 1949, 481-485.)

In this paper delivered before the 8th section of the Congress covering applied zoology and parasitology, the writer gave a short account of the history of our knowledge of plant parasitic nematodes and dealt with such matters as their means of dispersal in and upon the seeds of plants, the significance of weeds as reservoir hosts in maintaining infestations in the field and with the manner in which the root-knot nematode, *Heterodera marioni*, feeds on the giant cells which are formed within parasitized roots in response to its presence. He also indicated some of the problems associated with plant infestations due to species of *Aphelenchoides*.

98. GOODEY (T.). 1950. *Stem eelworm and clover.* (Proc. Ass. App. Biol. in Ann. Appl. Biol., **37**, 324-327.)

The history of stem eelworm infestations of clover in Europe since the early 19th century were dealt with and the chief biological differences between the races affecting rye and oats and that attacking clover were discussed. Symptoms manifested by clover plants infested with the true clover strain of the parasite were described. It was also shown that flower tissues may become attacked and that the parasite can be seed borne in which case control is possible by seed fumigation. The significance of weeds as reservoir hosts and the question of resistant varieties of red clover were briefly touched on.

99. GOODEY (T.). 1950. *The clover eelworm observed.* (The Farmers Weekly, **32**, 53 and 55.)

A more popular presentation of No. 10.

100. GOODEY (T.). 1950. Article on *Eelworm.* (In *Chambers's Encyclopaedia.*)

101. PETERS (B. G.). 1950. *Nematodes as crop parasites.* (World Crops, **2**, 11-15.)

102. PETERS (B. G.). 1950. *Controlling potato root eelworms.* (British Farmer, 31st October, 1950.)

103. PETERS (B. G.). 1950. *Potato root eelworm.* (Farming, **4**, 338-341.)

104. PETERS (B. G.). 1950. *Articles: Cestoda, Nematoda, and Trematoda.* (In *Chambers's Encyclopaedia.*)

Entomology Department

BOOK

105. BARNES (H. F.). 1951. *Gall midges of economic importance. Vol. 5. Gall midges of trees.* (Crosby Lockwood and Son, Ltd. 270 pp. and 8 plates.)

The fifth volume of the series deals with the gall midges of trees in two sections: those of coniferous trees and those of broad-leaved trees. About 300 gall midges receive attention. This volume contains, just as the previous ones, much information of an economic botanical nature.

PUBLICATIONS

106. BARNES (H. F.). 1950. *The need for biological investigations in the specific determination of gall midges.* (Proc. Eighth Int. Cong. Entomology, Stockholm, 106-110.)

A plea for biological investigations as a necessary aid to the correct identification of gall midges, giving, as examples, certain gall midge pests of cereals, cabbage, fruit and grasses as well as those feeding on aphids, coccids and rusts.

107. BARNES (H. F.). 1950. *The identity of the swede midge, with notes on its biology.* (Ann. App. Biol., **37**, 241-248.)

An account of biological experiments which show that the swede midge will attack the flower buds of great watercress (*Rorippa amphibia*) as well as the flower buds and leaves of turnip, swede, cabbage and radish. The correct name for this midge is *Contarinia nasturtii*, Kieffer, 1888 (syn. *Contarinia torquens* de Meijere, 1906; *Contarinia geisenheyneri*, Rübsaamen, 1917). It breeds by means of unisexual families.

108. BARNES (H. F.). 1950. *Worm eating slugs in Bedford gardens.* (Bedfordshire Naturalist, **4**, 23-25.)

A brief illustrated account of observation, weights, feeding and marking experiments on *Testacella haliotidea* and *T. scutulium*.

109. BARNES (H. F.). 1950. *Obituary Notice—Dr. A. D. Imms.* (Ann. App. Biol., **37**, 553-554.)

The late Dr. Imms was the first head of the entomology department.

110. EASTOP (V. F.). 1951. *Diurnal variation in the aerial density of Aphididae.* (Proc. Roy. Ent. Soc. Lond. (In the Press.))

The diurnal flight activity (with the double peak of aerial density) and the nocturnal quiescence found to occur in *A. fabae* is described for many other species of aphids.

111. JOHNSON (C. G.). *The dispersal of insects by wind.* (New Biology, **9**, 76-89.)

112. JOHNSON (C. G.). 1950. *The study of wind-borne insect populations in relation to terrestrial ecology, flight periodicity and the estimation of aerial populations.* (Sci. Prog., **39**, 41-62.)

This is a critical review of the present state of insect "aerobiology." Hitherto changes in insect populations in the upper air have often been studied by inadequate methods, and attempts have been made to interpret the changes in aerial density solely with meteorological conditions prevailing at the time of capture, without due reference to the correlated changes in terrestrial ecology and flight periodicity at crop level, which are the basis for subsequent aerial changes. This paper describes how the type of work in progress at Rothamsted and Cardington follows hourly and daily fluctuations in density at crop level, and aims to correlate these changes with the build up of vertical density up to 2,000 ft. during the day and its decline at night.

113. SOUTHWOOD (T. R. E.). 1950. *Deraeocoris scutellaris F. (Hemiptera, Miridae) taken in the light traps at Rothamsted, Hertfordshire.* (Ent. Mon. Mag. **86**, 78.)

114. TAYLOR (L. R.). 1951. *An improved suction trap for insects.* (Ann. App. Biol.) (In the press.)

The original model of the disc-dropping suction trap (described in Ann. App. Biol., 37, 80) has certain weaknesses of construction and design. This paper describes an improved design in which these weaknesses are rectified.

115. WILLIAMS (C. B.). 1950. *The biology of the seasons.* (New Naturalist J., 2, 1-14.)

A semi-popular account of the effect of seasonal changes on living creatures, and particularly a discussion on some problems of phenology, or the dates of occurrence of biological events. This is based on a long series of observations made by successive generations of the Marsham Family, in Norfolk, starting in 1740 and lasting with only one break to the present day.

116. WILLIAMS (C. B.). 1951. *A note on the relative sizes of genera in the classification of animals and plants.* (Proc. Linnean Soc., London, 162 (2), 171-175.)

A discussion of the application of statistical methods to certain problems of taxonomy and particularly the relative sizes of genera. It is found that in any group of animals or plants the number of genera with one, two, three, etc. species conforms closely to a "logarithmic series." This mathematical test can be used to see if a systematist is "consistent" but not if he is correct. The "lumpers" who allow few genera and the "splitters" who allow many genera for the same number of species, may both be consistent in the application of their principles, and both may be interpreting correctly the relationship of species at slightly different levels.

117. WILLIAMS (C. B.). 1951. *Changes in insect population in the field in relation to preceding weather conditions.* (Proc. Roy. Soc. Series B, 138, 130-156.)

An examination of the results of trapping of insects in light traps during two periods of four years separated by the war. It has been found possible to estimate the population changes from light trap catches by using the geometric mean catch (i.e. mean log) for each month, and then comparing the same month in successive years. This gives a measure of departure of the population from normality for the time of the year.

Using these values as dependent variables, and the rainfall and temperature departures from normal in each of the three previous months as independent variables, it is possible to calculate for each of the four seasons, a series of six regressions. With a knowledge of these it is then possible to estimate or forecast the probable population departure in any one month if the rainfall and temperature of the three previous months is known.

This has been done for the two periods of 48 months each, and the fit of the calculated to the observed change is extremely good. In the summer and autumn months 70 per cent of the variance of the population can be explained. In the winter 50 per cent and in the spring only 25 per cent. The changes in the regression during the four seasons show that rainfall has a high positive effect on the population in summer and autumn, but little effect in winter and spring. Temperature, on the contrary, shows a high positive relation in winter, little relation in spring and autumn, and a slightly negative relation in summer. In other words insects in general are in S.E. England more abundant in warm winters and wet summers, and less abundant in cold winters and dry summers.

118. WILLIAMS (C. B.) and LONG (D. B.). 1950. *Phase colouration in larvae of Lepidoptera.* (Nature, 116, 1,035.)

A letter calling attention to the discovery of differences in colouration and behaviour of larvae of *Plusia gamma*, the Silver-Y moth, according to whether they are crowded or kept isolated.

#### Bee Department

119. BUTLER (C. G.). 1950. *A new design of microsyringe tip for instrumental insemination of queen honeybees.* (Nature, 166, 957-958.)

A description of a syringe tip which enables the syringe to be held in the hand throughout the operation of introducing semen into the queen honeybee, and allows of easy introduction of the syringe without the use of a probe.

120. RIBBANDS (C. R.). 1950. *Autumn feeding of honeybee colonies.* (Bee World, **31**, 74-76.)

Concentrated (66 per cent) sugar syrup, fed to colonies of honeybees in autumn, results in the production of about one-third more ripe stores than does the same weight of sugar fed as dilute (38 per cent) syrup.

The elimination by the bees of each 1 lb. of surplus water from the syrup involved the utilisation of 4-5 oz. of the syrup. This wastage of syrup was not due to brood rearing, which was less when dilute syrup was fed. About 10 per cent more ripe stores resulted from the feeding of concentrated syrup in mid-September than from the feeding of the same amount in August.

121. RIBBANDS (C. R.). *Changes in the behaviour of honeybees following their recovery from anaesthesia.* (J. Exp. Biol., **27**, 302-310.)

Anaesthesia with chloroform had no effect upon the memory, subsequent foraging behaviour, or longevity of worker honeybees. Anaesthesia with carbon dioxide did not impair the memory but induced a permanent change in the behaviour of worker honeybees, thus the pollen collecting tendencies of bees so treated were either eliminated or markedly reduced. The treatment of newly emerged worker bees with carbon dioxide resulted in a reduction in their brood rearing and wax secreting activities, and caused them to commence to forage at an early age. The treatment had no direct effect upon the longevity of the bees concerned.

The effects of nitrogen anaesthesia were similar to those of carbon dioxide. The factor common to both these treatments is lack of oxygen.

#### Insecticides and Fungicides Department

122. ELLIOTT (M.), NEEDHAM (P. H.) and POTTER (C.). 1950. *The insecticidal activity of substances related to the pyrethrins. Part I. The toxicities of two synthetic pyrethrin like esters relative to that of the natural pyrethrins and the significance of the results in the bioassay of closely related compounds.* (Ann. App. Biol., **37**, 490-507.)

The toxicity as contact insecticides of the esters of ( $\pm$ )-3-methyl-2-allyl-cyclopent-2-en-4-ol-1-one with the natural (+)-*trans* and with synthetic ( $\pm$ )-*cis-trans*-chrysanthemum monocarboxylic acids has been compared with that of the natural pyrethrins. The comparison was carried out on five species of test-insects.

It was found that the figure for both the absolute and the relative toxicities of these compounds varied with the species used as test-subjects.

The factors involved in this variation are discussed. The extremes of variation of relative toxicity for the compounds with the natural acid were from about one-eighth as toxic as the pyrethrum standard when the spider *Macrosiphum solanifolii* was used as test subject to nearly four times as toxic as the standard with the larvae of the moth *Plutella maculipennis*. The fully synthetic material varied from about 1/16 as toxic as the standard to *Macrosiphum solanifolii* to nearly twice as toxic to the larvae of *Plutella maculipennis*. The compound with the natural acid was approximately twice as toxic as the fully synthetic material to three of the insect species, but the fully synthetic material was considerably more than half as toxic as the partially synthetic to the fourth test-species. It is pointed out that while it is widely recognised that large differences in relative toxicity may occur when the effect of chemicals of widely different structure and mechanism of action are compared on a number of different test-species, the fact that these differences may also occur with related chemicals, with presumably a similar mechanism of action, has not been clearly stated.

Even when the differences in relative toxicity are taken into account, the two synthetic pyrethrin-like esters still show high insecticidal activity.

It seems reasonable to suppose from the results that economic commercial synthesis of pyrethrin-like insecticides is not impossible.

123. WAY (M. J.) and HOPKINS (Barbara). 1950. *The influence of photoperiod and temperature on the induction of diapause in Diataraxia oleracea Linn, Lepidoptera.* (J. Exp. Biol., 365-376.)  
The induction of diapause in the pupa of *Diataraxia oleracea* is influenced by temperature and photoperiod during the larval stage. Low temperatures

and short photoperiods tend to induce diapause while high temperatures and long photoperiods tend to prevent diapause.

Diapause is not influenced by light intensity during the larval stage providing the intensity is above a certain minimum.

Diapause is prevented at high temperatures (30–34°C.) if the larvae are reared in darkness.

The photoperiod is operative as a factor influencing diapause only between the beginning of the moulting sleep prior to ecdysis to the last instar and the 3rd–5th day of the last instar. A single diapause-preventing photoperiod during the moulting sleep is probably sufficient to prevent diapause.

Diapause in *D. oleracea* is not influenced by photoperiodically controlled substances in the larval food plant.

124. WAY (M. J.). 1950. *The structure and development of the larval cuticle of Diataraxia oleracea (Lepidoptera)*. (Q. J. Mic. Soc., **91**, 145–182.)

The main layers comprising the soft cuticle of the *Diataraxia* larva have been defined and a study made of their formation during development of the 5th instar larval cuticle.

In soft cuticle the epicuticle is thrown into minute tubercles and consists of three layers—the cuticulin layer, the wax layer, and the cement layer. The cement layer lies outside or partly embedded in the wax layer, but it is either absent or extremely thin over the tips of the tubercles. A polyphenol layer is absent and it is suggested that this layer is only present in hard cuticle. Beneath the epicuticle is a thin, lightly tanned exocuticle approximately 0.5  $\mu$  thick. The 7–10 $\mu$  thick outer endocuticle is perforated by well-defined pore canals and consists of lamellae containing chitin fibres varying from 100–2000 $\mu$  in diameter. Pore canals are absent in the inner endocuticle, which when fully developed may be 50  $\mu$  in thickness.

A description is given of how the cuticle is laid down at the moulting period with an account of the function of the pore canals.

A study of Verson's glands suggested that the large gland cell secretes a lipoprotein which is discharged on the surface of the epicuticle to form the cement layer. The intercalary cell secretes a phenol which is responsible for the tanning of a plug that blocks the opening of the gland directly after discharge.

125. LORD (K. A.) and POTTER (C.). 1950. *The mechanism of action of organo-phosphorus compounds as insecticides*. (Nature, **166**, 893–894.)

This is a preliminary publication, full details of which are now in the press, describing studies which have been made on the anti-esterase activity of Parathion, HETP and TEPP using an insect tissue extract. The anti-esterase activity has been compared with insecticidal activity and TEPP content and some correlation between these three factors established. Some evidence is given to show that esterases other than choline esterase may be important when considering the mechanism of action of organo-phosphorus compounds.

126. LORD (K. A.). 1950. *A colour reaction applicable to the pyrethrins*. (Nature, **165**, 567.)

A reaction between carboxylic acid derivatives and hydroxylamine, the product of which gives a coloured complex with ferric chloride in acid solution, was found to apply to the pyrethrins and their synthetic analogues. Details of experimental procedures are given. The absorption spectra of the complexes obtained from a mixture of the natural pyrethrins purified by the nitromethane technique and the synthetic pyrethrin analogue, the d,l,-*cis-trans* chrysanthemum monocarboxylic ester of 3-methyl-2-allyl-cyclopenten-4-ol-1-one were measured and found to be closely similar to those of other carboxylic acid derivatives. The possible use of this reaction for the detection and estimation of the pyrethrins and its analogues is discussed.

127. LORD (K. A.). 1950. *The effect of insecticides on respiration. II. The effects of a number of insecticides on the oxygen uptake of adult Tribolium castaneum Hbst. at 25°C.* (Ann. App. Biol., **37**, 105–122.)

An apparatus for applying insecticidal dusts in a modified Barcroft respirometer is described. Using this technique the initial effects of a number

of insecticides including so-called inert dusts, and other finely divided materials some of which are used as diluents, on the respiration of *Tribolium castaneum* Hbst. was studied.

The effect of humidity on the action of inert dusts, in particular, aldicide was also investigated.

Of the insecticides tested, 3:5-dinitro-o-cresol (DNC), p-nitrophenyl diethyl thionophosphate (Parathion),  $\gamma$  isomer of benzene hexachloride ( $\gamma$  BHC), DDT, pyrethrins, toxaphene, chlordane, hexaethyl tetraphosphate, all produced an increase in oxygen uptake before killing, but lauryl thiocyanate did not. The effects of different concentrations of insecticide in the dusts was also studied for some of the insecticides.

128. LORD (K. A.). 1950. *The effect of concentration of poison and the amount applied on the toxicity of insecticidal dusts to adult Tribolium castaneum Hbst.* (Ann. App. Biol., **37**, 123-126.)

Using insecticidal dusts of DDT, Benzene hexachloride, and DNC under the experimental conditions, comparatively large changes in the amount of material of a given concentration are necessary in order to give appreciable differences in mortality, but small changes in the concentration of the poison will produce large differences in toxicity with a given amount applied. This relationship would appear to hold with a number of insecticides.

129. LORD (K. A.), part author. 1950. *Consultative committee on insecticide materials of vegetable origin. Report of the standing sub-committee of analysis of vegetable insecticides on the world-wide, collaborative analysis of pyrethrum flowers.* (London.)

#### Woburn Experimental Station

130. MANN (H. H.). 1951. *The effect of manures on the bolting of the beet plant.* (Ann. App. Biol.) [In the press.]
131. MANN (H. H.). 1950. *World cereals to-day: the millets.* (World Crops, **2**, 97.)
132. MANN (H. H.). 1950. *Maize growing for grain in England.* (The Countryman.)

#### General Publications

133. OLDERSHAW (A. W.) and GARNER (H. V.). 1949. *Liming experiments on light sands at Tunstall. Part 2. The agricultural aspects.* (J. Roy. Agric. Soc., **110**, 89-98.)
134. GARNER (H. V.). 1950. *Sugar beet irrigation.* (British Sugar Beet Review, **18**, 145-150.)
135. GARNER (H. V.). 1950. *A fertilizer programme for winter wheat.* (British Farmer, September 30th.)
136. GARNER (H. V.). 1950. *Liquid manure losses.* (Farmer and Stockbreeder Year Book, 73-75.)
137. OGG (Sir W. G.). 1950. *Weather and food.* (Centenary Proc. R. Met. Soc., 239-243.)
138. OGG (Sir W. G.). 1949. *The part played by phosphorus in agriculture.* (Journées du Phosphore, Paris, January 1949.)