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Report for 1948

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Rothamsted Experimental Station
Harpenden

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Introduction

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INTRODUCTION

By the Director

Staff

Several members of the staff left during the year to take up University and other posts. Most of the vacancies have been filled and one or two new appointments made. Dr. Winifred E. Brenchley retired from the headship of the Botany Department at the end of September and was succeeded by Dr. D. J. Watson, head of the Crop Physiology Section, which has now been merged in the Botany Department. At a large gathering of present and past members of the staff, a presentation was made to Dr. Brenchley and tributes were paid to her outstanding services to agricultural science and to the Station over a period of 42 years.

As mentioned in last year's report, the research work on plant nematology has been transferred from the Institute of Parasitology at St. Albans to Rothamsted and during the year Dr. T. Goodey, F.R.S. and his staff moved into the new laboratories built for them.

Professor R. Mannkopff and Mr. H. Albrecht of Göttingen spent about seven months at Rothamsted and with their assistance a spectrograph with glass prisms was built. Professor Mannkopff also gave a short course of instruction on spectrographic methods which was attended by workers from other institutions.

The director and Dr. A. Muir spent a short period in the Middle East studying soils in relation to the corrosion of oil pipe lines between the Persian Gulf and the Mediterranean. Mr. Seale of the Soil Survey has been seconded for a year to continue this work.

During the year there were 17 long-term and 23 short-term voluntary workers at the Station. Again, many applications had to be refused owing to lack of accommodation.

Visitors

The number of visitors to Rothamsted in 1948 continued at the high level reached in the previous year, the total being over 5,000. The Station provided facilities and arranged demonstrations for the following conferences—National Agricultural Advisory Service Crop Husbandry Specialists, Commonwealth Conference on Tropical and Sub-tropical Soils, Royal Meteorological Society, Commonwealth Mycological Conference, Commonwealth Conference of Entomologists, and the International Geological Congress. There were a few visitors from ex-enemy countries, including two parties of German agriculturists and economic experts.

The conference on Tropical and Sub-tropical Soils, arranged at the suggestion of the Soils Sub-Committee of the Committee for Colonial Agricultural, Animal Health and Forestry Research, was held under the ægis of the Commonwealth Agricultural Bureaux. The meetings were at Rothamsted from 14–19th June and were attended by leading soil workers from the Commonwealth. Representatives from the Food and Agriculture Organization of the United Nations, the United States, France, Belgium, Holland and Palestine were also present as observers. The conference was opened by Mr. D. R. Rees-Williams, M.P., Under-Secretary of State for the Colonies. The second half of the conference took the form of soil excursions in the south of England.

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Accommodation

The new building to house the Nematology Department has been completed and is in use. The concrete road from the laboratories to the farm buildings and six new farm cottages have been completed. Plans have been submitted to the Ministry for the adaptation of Rothamsted Manor as a Hall of Residence. Part of it will be used as a hostel for single workers, and part to provide a number of small flats. The outbuildings are being altered to provide space for soil and other samples, thus releasing the old Sample House and Annexe at the laboratories for library purposes and for an institutional store for chemicals and apparatus.

The Work of the Station

The Pedology Department is now equipped and investigations have been commenced on rock weathering and soil formation. Other work includes a study of the gleying process in ill-drained soils and X-ray examinations of clays. The spectrographic section has suffered a serious set-back through the death of Dr. J. B. Hale. In the Chemistry Department field experiments have been continued on the manuring of sugar beet and peas and on sewage sludges and composts of sludges and straw. Part of the sewage sludge work has been published. Extensive field work has also been done on fertilizer placement and on the manuring of forest nurseries. The Classical experiments and various others dealing with crop rotations and manuring have been continued at the Rothamsted and Woburn farms. The laboratory studies include work on soil organic matter, manganese and fluorine. The Biochemistry Department is also engaged on manganese investigations.

In the Physics Department field work has been continued on deep and shallow ploughing and, in co-operation with the Chemistry Department, on an irrigation experiment at Milford in Surrey. Progress has been made with meteorological studies, particularly on the measurement of evaporation. On the laboratory side the work includes measurements of the volumes of solids, water and air in soil clods and studies on vapour pressure in aqueous solutions and on the thickness of water films. An interesting new line of work is on the thermodynamic potentials of soil constituents with a view to obtaining further information on what plant roots may be able to take from the soil.

The Soil Microbiology Department has an extensive programme of soil studies. This includes a survey of the micro-population of Broadbalk field, a comparison of direct microscope and plate counts of bacteria in soil and studies on myxobacteria and amœbæ. Work on nitrification has been continued and an investigation made of the effect of micro-organisms on soil structure. It has been found that fungal mycelia can have a considerable influence on the formation of soil aggregates. The work on mycorrhiza has been continued and some progress has been made with this difficult investigation. One of the major lines of work in the Microbiology Department is on nodule bacteria. This includes a geographical study of the distribution of strains of clover nodule bacteria, a large experiment, based on field trials, on the establishment of these bacteria when inoculated into field soil and a test to compare the effectiveness of local strains of bacteria on local clover strains and on clovers from

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other places. Other work dealt with the dissociation of clover nodule bacteria in the soil and under the action of bacteriophage. The investigation on the genetical factors affecting nodule development has been written up and the work on the physiology of infection has been continued.

Water-culture studies on trace elements have been continued in the Botany Department, particularly on molybdenum. Further work has been done on weeds and special attention given to wild oats. The usual observational records have been made of the weeds on Broadbalk and Hoos fields and work has been carried out on the vitality of buried weed seeds. The data from the botanical analyses of hay from the Park Grass plots are now being written up. Work on the physiology of roots with particular reference to nutrient absorption has been continued.

In the Plant Pathology Department progress has been made with the studies on the serological, chemical and physical properties of viruses. Close collaboration has been maintained with the Biochemistry Department in this work. Various viruses were found to infect through roots when added to soil in which plants were growing and evidence was also obtained that culture solutions containing roots of infected plants could be infective. Field investigations on the spread of virus diseases were carried out on sugar beet, potato and lettuce. The factors studied were proximity to sources of viruses and aphides, variations in nutrient and water supply, planting date and density of crop. Mangold clamps were again found to be important overwintering sites for *Myzus persicæ* and *Hyperomyzus staphyleæ* and infestations of the former but not of the latter can be prevented by close topping before clamping. Roguing infected potatoes was ineffective in preventing spread of leaf roll and rugose mosaic unless done before July. The mycological work included studies on Take-all and Club-root and work was started to find control measures for sugar beet seedling disease now becoming increasingly prevalent. An investigation of the factors influencing the dispersal and distribution of spores has been commenced and a wind tunnel has been designed to obtain results under controlled conditions. In the Biochemistry Department, in addition to the soil work already mentioned, the decomposition of leaves by enzymes derived from the digestive juice of snails is being investigated. Work is also in progress on proteins of normal leaves that resemble viruses in their physical and chemical properties. Preliminary work is being done on the extraction on a technical scale of proteins from leaves. Mr. M. V. Tracey has published a book entitled "Proteins and Life".

The Nematology Department is concerned with eelworm parasites of plants that can be conveniently grouped under two main heads: (1) those which attack stem and shoot structures, e.g. the stem-bulb eelworm, *Anguillulina dipsaci*, and bud and leaf eelworms, e.g. *Aphelenchoides fragariæ*, (the strawberry bud eelworm) and *Aph. ritzemabosi* (the chrysanthemum eelworm); (2) those which attack the roots of plants and form cysts which finally fall into the soil where they remain as a source of infection, e.g. *Heterodera rostochiensis* (the potato root eelworm), *H. schachtii* (the sugar beet eelworm) and *H. marioni* (the root knot eelworm, a greenhouse pest). Investigations on the stem eelworm mainly

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dealt with various of its biological races and their ability or inability to transfer to other host plants, in particular to the onion, and to weeds. Work was also done on the potato tuber-rot eelworm, a species distinct from the stem eelworm, and it was confirmed that it can persist in the underground stems of corn mint, a common weed of potato fields in the Fens. Work on strawberry bud eelworm showed that two species of *Aphelenchoides* are often implicated in the trouble, one of them being the fern-blotch eelworm. Investigations on root eelworms, *Heterodera* spp., were largely devoted to the completion of the A.R.C. field trials in which the nematocidal effects of a soil fumigant, D–D mixture, were tested on 7 different potato soils involving the injection of D–D at 3 different rates and 2 different depths.

In the Entomology Department the investigations on insect migration have been continued but there were practically no outbreaks of migrant pests in this country during the year. The work on the relation of insect abundance and the relative abundance of species has been further developed and some of the general principles have been found to apply to plant populations as well as to insects. The study of Gall Midges has been continued and Dr. Barnes has published two further volumes of his work on "Gall Midges of Economic Importance". The swede midge was found infesting flowers of wild cress (*Rorippa amphebia*) at Bedford, thus settling a long-disputed point about its occurrence on wild host plants in this country. Further progress has been made with the investigation on drift of Aphidæ in the upper air and much help and co-operation has been obtained from the R.A.F. at Cardington. Aphidæ in relatively large numbers have been trapped at levels from 50 to 4,000 ft. A successor to Dr. Evans has been appointed, and the work on soil insects and earthworms will be continued.

In the Bee Department the study of the principles underlying the foraging behaviour of the honeybee has been continued. It has been found that after anæsthetics bee behaviour changes and this may throw light on its physiological basis. Experimental studies have also been made of the behaviour of worker bees when seeking an entrance to the hive and of pollen collection by bee colonies. The work on possible harmful effects of various herbicides and insecticides has been continued in conjunction with the Insecticides Department. A start has been made in a programme of work to produce by means of artificial insemination queens for all the department's experimental colonies. Further trials of the sulphonamide treatment of American Foul Brood indicate that it is improbable that this treatment will have practical value. Work has been commenced on European Foul Brood.

The work of the Insecticides Department has, for the most part, continued along lines designed to give fundamental information which will help to place the search for new insecticides on a more rational basis and to enable existing materials to be used to the best advantage. Work of more immediate application has been done on the insecticidal activity of benzene hexachloride and on the new organic phosphorus compounds hexaethyl tetraphosphate (H.E.T.P.) and diethyl-p-nitrophenyl thiophosphate (E.605). In addition a considerable amount of work has been done on the methods of analysis of pyrethrum as part of a collaborative scheme.

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A field experiment to compare the effectiveness of a number of compounds for the control of wireworms has been carried out. The advent of new synthetic insecticides has opened up the possibility of large-scale insect control in agricultural practice which was previously only economically possible to a very limited extent. This calls for an extension of field work for which the department is not, as yet, well equipped. During the course of work on the effect of the physical state of the insecticide on its toxicity, it has been found that the particle size of suspensions of rotenone, the most active constituent of the derris group of insecticides, has a very large effect on its insecticidal activity when applied as a contact poison. Differences in toxicity of several hundred times have been recorded. Work had been started on the effect of insecticides on insect respiration as a preliminary to more detailed studies on the biochemical mechanism of action of insecticides. Work on the more general problem of the relationship between molecular structure and insecticidal activity has also been begun with pyrethrum as the first subject for study. The structure and physiology of the caterpillar cuticle has been investigated in order to provide a basis for work on the action of contact insecticides which must penetrate the cuticle to arrive at their site of action. Photographs with the electron microscope have provided a great deal of potentially useful information.

The work of the Statistical Department has consisted mainly in the design and analysis of experiments for workers in this country and abroad and in the planning and execution of large-scale sampling surveys. The usual work has been done on the current year's experiments at Rothamsted and a new long-period investigation comparing various ley and arable rotations has been designed. Much assistance has been given to the National Agricultural Advisory Service and the work for the Colonies has included the analysis of long-term experiments on coffee in Tanganyika and investigations on mealy-bug in West Africa. Large-scale surveys have been made on certain aspects of fertilizer practice and on methods of milk production. A survey of maincrop potatoes has been carried out to obtain information on the agricultural practices followed in growing the crop and to test methods of estimating the yield by sampling. Other work included an examination of the accumulated pre-war data of the Agricultural Meteorological Scheme and an investigation of sampling errors in connection with chemical determination of fertilizer requirements. Dr. Yates has completed a text-book on sampling methods in censuses and surveys.

At Woburn Dr. H. H. Mann has continued his pot and field experiments including his investigations on hybrid maize, sweet lupins for forage, soya beans and serradella.

The large programme of field experimental work on the farms at Rothamsted and Woburn has been carried out in a very satisfactory manner and excellent co-operation obtained from the farm manager and his staff.