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Report for 1956

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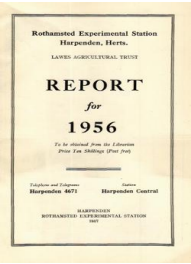
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Entomology Department

K. Mellanby

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ENTOMOLOGY DEPARTMENT

K. MELLANBY

GENERAL

H. F. Barnes spent two and a half months in Canada and the U.S.A., attending the Tenth International Congress of Entomology at Montreal and afterwards visiting research stations, agricultural colleges and universities in Ontario, Washington, D.C., Missouri, Kansas, Nebraska, Iowa, Minnesota and New York State.

F. Raw returned from secondment to the West African Cocoa Research Institute in Ghana. C. G. Johnson departed on secondment to the same institution in December; he will take up duties as Acting Director for three months, and then remain for a further year as Chief Entomologist.

P. W. Murphy and R. M. Dobson attended the 5th Congrès International de la Science du Sol in Paris and read papers. P. W. Murphy read a paper on the rôle of soil acarina in the decomposition of leaf litter at the British Association meeting at Sheffield.

J. C. da Silva Dias of the Portuguese Agricultural Service (British Council Scholar) joined the department.

G. W. Heath was awarded the Ph.D. of London University, having submitted a thesis entitled *Biological Studies in Gall Midges* (*Cecidomyidae*).

The work of the department has been seriously inconvenienced by the delay in erecting insectaries and glass-houses adjacent to the West Building. Makeshift accommodation for rearing insects is still in use at Rothamsted Lodge, and much time is wasted travelling between the buildings. Experimental work is also hampered by the delay in fitting up the constant-environment rooms.

INSECT MIGRATION

(R. A. French)

Work has continued on the migration of Sphingidae and other insects in Western Europe. Light traps were worked from April to the end of October, in order to have additional data to compare with Dr. C. B. Williams' finding in Inverness-shire. A further comparison of the results of trapping in different environments on the farm was made with J. C. da Silva Dias.

GALL MIDGES OF ECONOMIC IMPORTANCE

(H. F. Barnes, Barbara M. Stokes and D. L. Milne)

The long-term study concerning the two wheat blossom midges was carried out for the thirtieth successive year. Insectary observations showed that, while 25 per cent of the 1955 *C. tritici* large larval population emerged, the relative parasitism was 22 per cent. In contrast the relative parasitism of the 1955 *S. mosellana* was 97

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per cent, while that of the total flight, which only covered the last eight years' populations instead of the previous thirteen, as occurred in 1955, was 73 per cent. Thirty-two per cent of the emerging *S. mosellana* was derived from the 1951 larval population, whereas just under 2 per cent came from the 1955 larvae. Practically 40 per cent of its parasites that emerged in 1956 were derived from the 1953 larvae and 27 per cent from those of 1955, while the remainder came from the larvae of 1950, 1951, 1952 and 1954. On Broadbalk the wet weather enabled the larvae of both species to leave the wheat ears as soon as they had completed their feeding. The adjusted figure for numbers of *C. tritici* larvae was 18,656, as compared with the actual 24,604 in 1955, giving a 7 per cent floret infestation (9·4 per cent in 1955). The number of *S. mosellana* larvae dropped from 2,232 in 1955 to the exceptionally low one of 105 in 1956, the percentage grain infestation being less than one-half of 1 per cent (7·3 per cent in 1955).

The attempt to obtain adults from some of the numerous *Haplodiplosis equestris* larvae of 1955 was unsuccessful. It was observed that very few larvae were present in 1956 on Broadbalk and Hoosfield. But apparently in Yugoslavia this species occurred in sufficient numbers on wheat, barley and rye to attract attention and was particularly injurious to the rye. Likewise in Denmark there were enormous numbers of the larvae in a certain ryegrass seed sample; presumably following a severe infestation of this grass.

On the other hand, adults of the *Contarinia* species on timothy grass inflorescence received from Finland in 1955 emerged in large numbers. At the same time considerable numbers of a *Stenodiplosis* species were discovered ovipositing on this grass at Rothamsted. It is interesting to note that three species of gall midges are now known to cause seed loss in this valuable grass, the third being the *Dasyneura* larva found at Silwood Park in 1953.

Further evidence of the importance of gall midges in grass-seed production was afforded by the fact that Prof. Dr. Muhle sent in for identification from Bavaria a new *Dasyneura* species from *Poa pratensis*. Previously only two species, *Contarinia poae* Tomaszewski and *Sitodiplosis cambriensis* Jones, were known from the inflorescences of this grass.

Experimental work was begun to test the possibility of development of races of *Mayetiola destructor*, the Hessian Fly, more specific to certain host plants than the fly now found at Rothamsted, following the development of strains showing varietal preferences in other countries. This entails breeding " lines " of flies each confined to a single host plant for a number of generations and finally testing them for host-specificity with midges whose host plants have been changed with each generation and with midges from the field. Difficulties have been encountered in maintaining the " lines " owing to the occurrence of unisexual families, but interesting data on this phenomenon are accumulating. The occurrence of Hessian Fly on Broadbalk and Hoosfield wheat–alternate fallow was again estimated.

Work on the life history of *Mayetiola dactylidis* on cocksfoot was continued. Its biology differs from that of *M. destructor* in many respects, and so far it has never been found to interbreed with this

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species. *M. dactylidis* has been collected from many localities on Rothamsted farm, but infested cocksfoot shoots are difficult to detect, even when they contain a dozen or more larvae, for the outer leaves bear little sign of damage, although the central leaf tissue is often reduced to a rotting mass.

An interesting new rearing is that of a *Mayetiola* species from the stems of meadow foxtail grass. This was from larval material sent from the Grassland Research Station, Hurley, by Dr. G. W. Heath. Its presence there had been recently established by Dr. I. W. B. Nye. The only previous record is that of larvae found near Aberystwyth by Dr. E. E. Edwards nearly thirty years ago. This species, also subsequently found at Rothamsted by Barbara Stokes, is particularly interesting owing to its possession of a bifid breast-bone.

Further biological evidence was collected supporting the separation of the *Dasyneura* midges found on clover into *D. gentneri*, which normally oviposits on open flowers of white clover but can produce fertile offspring as the result of laying on open red clover, and *D. leguminicola*, which will only oviposit on green heads of red clover. This evidence includes observations on emergence, sex ratio, duration of life cycle, mode of oviposition, larval colour and other biological factors which aid in the determination of the exact taxonomic relationship between two such apparently closely allied species. The attack of white clover by *D. gentneri* was widespread in 1956, and the midge was present in samples from twenty-four counties of England and Wales. Larval observation tubes were set up, and it was found that in both species of *Dasyneura* the sternal spatula or breast-bone is used for moving obstacles when burrowing into the soil and when clearing a space for cocoon-spinning.

Three additional hymenopterous parasites of *D. leguminicola* were identified by the staff of the Natural History Museum, London. These are: *Tetrastichus inunctus* Nees, *Prostatogaster demades* Walker and an *Aphanogmus* species.

The most interesting fact to emerge from this year's studies on clover midges was the discovery of another midge definitely causing seed loss in red clover, and therefore of potential economic importance. This may be *Hadrobremia longiventris* Kieffer, that was previously thought unlikely to be phytophagous. This year, however, large numbers of larvae were present in samples from more than nine counties, and preliminary studies of its biology were made. It is hoped to continue investigations on this species during 1957.

Among the more interesting gall midges received for identification were some reared from fungi by Miss Kitty Paviour-Smith, who is studying at Oxford the community of macro fungi growing on dead and decaying wood; the *Heteropeza* species, swarms of which occurred on the wing in some commercial mushroom houses early in the year, usually only the paedogenetic larvae are to be found; larvae found in the stems of cotton-grass; the larvae from blue tits in pine woods sent by Miss Monica M. Betts, who is studying the food of these birds. From overseas inquiries concerning coccid-eating midges came from Spain, Sao Tome and Jamaica; a sorghum stem midge and a benniseed capsule midge from Mr. K. M. Harris in Nigeria; additional specimens from *Stachytarpheta* in Trinidad

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and British Guiana from Mr. F. D. Bennett in connection with the biological control of this tropical weed; and midges found in New Zealand on *Boronia* from West Australia. Further acquisitions for the collection include specimens of the recently described genus and species *Kittada coimbatorensis* Agarwal, *Miastor americana* Felt and *Schizomyia impatientis* O.S.

Mr. W. Nijveldt, on the staff of Instituut voor Plantenziektenkundig Onderzoek, Wageningen, spent two weeks studying the aphid-eating gall midges in the collection.

Wheat Bulb Fly Studies

Host plant selection (Barbara M. Stokes)

Observations on the possible preferences of wheat bulb fly larvae among its various host plants were continued in pot experiments.

New methods for studying the ways in which newly hatched larvae find their host plants have been tried in the laboratory with promising results. In a series of experiments larvae moved into cubes of alginate jelly taken from a petri-dish in which wheat had been grown, although they contained no part of the plant, and showed no such response to similar cubes of jelly taken from dishes in which no wheat had been grown. Work on larval responses to various stimuli and on the constitution of the substance in the wheat jelly is being continued and extended.

Field studies on oviposition, emergence and survival (F. Raw, R. M. Dobson, J. W. Stephenson and J. R. Lofty)

The experiment on Broadbalk, to estimate the effect of infestation on yield by screening strips of plots to prevent oviposition, is being repeated. On the fallow section of plots 2, 3, 5, 7 and 10 two strips each 6 feet wide and running the width of the plot were screened with mosquito netting during the oviposition period. At harvest 1957 the yield from these strips will be compared with that of similar unscreened strips to give an estimate of the effect of infestation on yield.

A new technique, combining the use of a large field emergence cage with the method of marking and recapture, has been developed to facilitate field studies of populations of wheat bulb fly adults. The cage, 24 feet long, 12 feet wide and 6 feet high, was made of terylene netting on a light metal framework and had very little effect on climatic conditions inside it. It was set up in an infested wheat field shortly before the flies emerged and was searched for flies twice daily throughout the emergence period. Newly emerged flies were marked with paint to indicate the date of capture and were then immediately released inside the cage. Marked flies were subsequently recaptured at regular intervals. The data provided information on the following points:

1. Total number of flies of each sex emerging within the cage. This could be related to the numbers of larvae and pupae previously estimated.
2. Rates of build-up and decline of the population of both sexes.

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3. The structure of the population in terms of sex ratios and absolute numbers throughout the life of the adults.

Larval studies (D. B. Long)

The continued spring survey of infestations following various crops showed that the population had made some recovery after the drastic reduction in the winter of 1954/55. For example, the population on the wheat and fallow plots which had fallen in 1955 from 1,038,000 to 215,000 larvae/acre rose in 1956 to 583,000 larvae/acre. In general, the greatest infestation occurred in the wheat plots of the six-course rotation experiment with 800,000 larvae/acre involving 55 per cent of the plants at the time of sampling.

The observation made in pot experiments in 1955 that although wheat bulb fly is a major pest in the Fenlands, infestation of wheat was very much more successful on Rothamsted clay-loam than on Fen peaty-loam, was confirmed in 1956. The highest infestation of wheat grown in pots of clay-loam set up at different pH levels within the wheat tolerance range occurred in soils of pH 5·5–6·5. Whilst a lower level was found in alkaline soils up to pH 8, an acid soil of pH 4·9 produced a marked reduction. These experiments, coupled with those using Fen peaty-loam, showed that although the pH factor could influence the infestation, this was not the factor responsible for the very poor infestations obtained with peaty-loams.

From the continued studies on larval movements in soil it appeared that newly hatched larvae move directly upwards towards the surface, restricting their subsequent movements to the top 1–2 inches of soil. These experiments are being continued.

Observations on the adult (D. B. Long)

Field observations on the adult fly were continued, and several previous findings were confirmed. Attempts made to follow the dispersion of flies over Broadbalk throughout the summer were frequently interrupted by bad weather. At first both males and females were found to spread out fairly uniformly from the central emergence section, and their patterns of dispersion over the field coincided. As the season progressed, however, the patterns of dispersion became less coincident as the males congregated towards the northern edge of the field. In general, fly populations appeared to be mostly localized round infested wheat fields.

The earlier finding that flies tended to avoid laying eggs near a vertical screen was confirmed, and observations suggest that this was partly due to an optical effect involving contrasts of light and shade. Experiments have shown that light plays a major part in the maintenance of the oviposition rhythm earlier observed. Light may also be responsible for the much lower level of egg laying that had been found to take place in tall crops such as beans or wheat. An experiment set up on Long Hoos VII to study the oviposition preferences between fallows and stands of wheat at different plant densities proved inconclusive due to the extraordinarily low level of the subsequent infestation; 1·8 per cent of the plants following fallow and 0·09 per cent of plants following wheat being infested.

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The site is near to the heavy infestations on the six-course experiment and the wheat and fallow strip, and since flies were known to be in the area, it may be concluded that flies do not lay at random on all available fallow ground.

In the laboratory it has been found that flies tend to lay eggs at intervals and that the rate of egg laying increases with the age of the fly. Most of the eggs obtained were laid by relatively few individuals.

In work begun on nutrition and feeding responses the fly has been found to be most sensitive to the sugars.

A study of pathogenic fungi has been started with E. W. Buxton (Plant Pathology Department).

Aphid Ecology and Insect Dispersal

Periodism and energy summation (C. G. Johnson and L. R. Taylor)

The mechanism of diurnal flight rhythms in *Aphis fabae* and similarly behaving species has largely been solved; and in doing this a principle of wide application to periodic change of a more general nature (e.g. population growth and decline) has been put forward. A rhythmic change in the number of aphids flying off a breeding site during the day depends primarily on a fluctuating source of energy—in this case heat—which, by producing a fluctuating rate of development, also produces as a consequence an alternate increase and decrease in numbers of alatae produced. By a process of energy summation this periodicity can be reconstructed theoretically.

The next step is to extend this principle to the periodic growth of populations in aphids and also in other insects. A start has been made with this: it involves field and laboratory work on the effects of temperature in the duration of development.

Duration of teneral development in A. fabae (L. R. Taylor)

Three important facts have come from a study of the teneral stage of alate *A. fabae* in relation to temperature. First, that the mean temperature of a fluctuation ranging between approximately 7° and 34° C. has virtually the same effect on development time as a constant temperature equal to the mean. This implies that some work formerly done in the laboratory may now be safely done in the field, and vice versa. Secondly, a method of successive approximations in fitting curves of variable field data has been developed which assesses the mean temperature and mean developmental period with great accuracy. Thirdly, the possibility that the temperature-development curve is to be seen as a frequency distribution rather than as a functional relationship (as hitherto) may open up a new theoretical approach to temperature relations in biology.

Flight inhibition in aphids (A. J. Cockbain)

It is known that aphids cease to fly when the temperature falls below a certain value. Using captive flying aphids in a small wind-tunnel, a study has been made of the influences of flight duration and of humidity on this threshold, with *A. fabae*.

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It was found that the threshold for wing-beat movement is negatively related to duration of flight and that high humidities are associated with a high threshold, and vice versa.

Vertical dispersal of insects (C. G. Johnson and L. R. Taylor)

This work continues. A general, empirical expression has been found which relates density to altitude for many classes of insect. The mathematical and the vertical aspects of insect diffusion are being studied in collaboration with Mr. J. G. Skellam of the Nature Conservancy.

Much data have been collected on the hourly change in vertical density profiles in relation to atmospheric stability. Detailed analysis of these results proceeds.

Wireworm Populations

(F. Raw, J. W. Stephenson and J. R. Lofty)

The studies of wireworm populations begun in 1950 on the ley and arable rotations in Highfield and Fosters have been concluded. The results, which now cover two complete crop rotations, are being prepared for publication.

Effects of Insecticides on Soil Fauna

(R. M. Dobson, J. W. Stephenson and J. R. Lofty)

The observations carried out by invitation of Messrs. Plant Protection Ltd. on material taken from their field experiment at Haslemere in autumn 1955 are now almost complete. This experiment was designed to study the long-term effects of BHC applied yearly or every fourth year to the soil in a four-course rotation (swedes, barley, ley, wheat), and allows rotational and insecticidal effects to be assessed independently. Field observations were made one year after the last application of insecticide. The rotation caused large fluctuations of soil populations. Collembola increased during the second year and then decreased. Mesostigmata (Acarina) continued to increase until the third year. Both groups were greatly reduced during the fourth year. The BHC treatments caused a general reduction in the numbers of most groups, and sometimes modified the fluctuation caused by the rotation e.g., on treated plots subterranean Collembola were at their maximum during the third year instead of the second. This group was also exceptional in that the highest populations occurred on the plots treated annually and the lowest on the controls. Mesostigmata appeared to be unaffected by the treatments.

Earthworm Studies

Rehabilitation of marginal grassland (R. M. Dobson and J. R. Lofty, in conjunction with Dr. E. Crompton of Durham University)

The experiments in Lancashire to investigate the rôle earthworms play during the rehabilitation of marginal grassland have continued.

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It has not yet been possible to apply the manurial treatments on the Rivington site, but the experiment at Lancaster is proceeding satisfactorily. The operations carried out here so far have been: liming—summer 1954; phosphate and farmyard manure applied—summer 1955; lead arsenate spraying—autumn 1955; grass burning and application of artificial fertilizers—spring 1956; mowing of plots and second application of phosphate and farmyard manure—autumn 1956. A second application of artificial fertilizers will be made in spring 1957.

A survey made in September 1956 showed that the lead arsenate treatment had successfully reduced the earthworm population on the treated halves of the split plots. So far the various manurial treatments show little effect.

Earthworm populations in orchards (J. W. Stephenson)

The effect of repeated applications of fungicides and insecticides on the earthworm population of orchards and the rate of removal of surface litter is being investigated.

Excessive casting by earthworms (J. W. Stephenson)

Reports were received of excessive earthworm casting in an area of Fryupdale, Yorks, where, at harvest, wormcasts were frequently found 12–18 inches high in corn stooks, making it difficult to obtain clean grain when threshing. A brief survey of the area showed a high population of the casting species *Allolobophora nocturna* (Evans). Further investigations will be made in co-operation with Durham University Zoology Department.

Millipede Studies

(J. W. Stephenson)

A method for culturing millipedes using plaster-of-Paris cells with glass plates top and bottom has been developed. The method permits details of copulation, nest building, emergence from eggs and moulting to be observed. Moulds which have been troublesome hitherto do not appear to thrive in the cells.

Studies on Beetles

(R. M. Dobson)

This work has largely been held in abeyance during the past year, but routine identifications of *Carpophilus species* (Nitidulidae) have continued. A field experiment designed to study diurnal rhythms in flea-beetles had to be discontinued due to destruction of the seedlings by birds.

Ecological Studies on the Natural Enemies of Aphids

(C. J. Banks)

Investigations were carried out to examine the evidence that ants, attending aphids for the honey dew they excrete, protect them from the attacks of natural enemies and, at the same time, cause them to multiply more rapidly than aphids which are ant-free. *Aphis fabae*

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and the common garden ant, *Lasius niger*, which sometimes attends it, were used in the experiments.

It was confirmed that some predators were attacked and driven away from the aphids on the bean plants by the ants; other predators, including the parasite *Aphidius*, were not attacked. In the absence of the enemies, the aphid colonies tended by the ants sometimes multiplied more rapidly than controls, the results confirming those of some other workers. But in some experiments there was no difference in aphid numbers on ant-attended and ant-free plants, a problem which will be investigated during 1957.

Experiments were also started to assess the effectiveness of various species of predators of *Aphis fabae*. Numbers of predators were put on to caged bean plants infested with known numbers of aphids; another cage with equal numbers of aphids on similar plants was used as control. A comparison of the aphid numbers remaining on the two sets of plants gave an estimate of the numbers of aphids destroyed by the predators, and the results could be compared with those from experiments in which other predator species had been used.

Late-stage Coccinellid larvae were very effective in quickly destroying the bulk of the aphids, but the larvae left the plants without having eaten them all; some aphids remained hidden between leaflets at the tops of the plants. Previous studies on the behaviour of these predators had shown that they tend to stay on the plants when there is food readily accessible.

On the other hand, small insects like the Anthocoridae were able to get into crevices and destroy the aphids there but were unable to eat as large a total of aphids as the coccinellids. Chrysopid larvae, although provided with long piercing and sucking mouth parts, were surprisingly ineffective in reducing aphid numbers. Further work on these and other predators will be continued during 1957.

Control of *Aphis fabae* by its Natural Enemies

(C. J. Banks)

To supply much-needed quantitative information on how entomophagous insects affect the numbers of an aphid pest like *A. fabae*, experiments were started in the spring of 1956 in collaboration with M. J. Way of the Insecticides Department.

Natural populations of the aphid and of its insect enemies are being studied on the winter host-plant (*Euonymus europaeus*) and on the summer host-plants (beans and *Chenopodium*) also, caged plots of these plants were artificially infested with equal numbers of the aphids at various times throughout the spring and summer. From one type of cage entomophagous insects were excluded by dieldrin-treated terylene netting; in another, parasites and predators entered the cages between slats on the walls which were adjusted to give climatic conditions comparable to those in the other type of cage. Sticky traps were set up in the localities studied to give estimates of the abundance of flying predators and aphids during the year. The caged plots, from which predators were excluded, developed much larger aphid populations than the plots where the insect enemies were free to enter.

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Natural populations on *Euonymus* in spring were very small, and comparatively few alatae migrated to beans, where only small infestations developed, in contrast to the heavy artificial infestations in the cages. Populations of predators remained low in number and were unable to multiply on the few aphids on beans and, later, on *Chenopodium*. In November and December fair-sized populations of the aphid developed on *Euonymus* once more and there laid eggs. If insect enemies play an effective rôle in the complex life cycle of the aphid it is possible that a large population of aphids will develop during 1957, and this in turn should allow predators once more to multiply rapidly.

Effects of Population Density on Insects

(D. B. Long and M. A. Zaher)

Experiments have been carried out on the effects of the larval population density on adult Lepidoptera. The species used were *Plusia gamma* and *Pieris brassicae*; experiments with the cotton leaf worm *Prodenia litura* being terminated by latent virus infection.

Adults from crowded larvae are generally smaller in size and weight than their solitary counterparts; there are also differences in the ratio between the length of the fore-wing and the hind femur (the ratio of wing to femur length is greater in crowded than in solitary forms) which reflect effects previously observed in larval development.

It has also been observed that at the end of their development crowded larvae had a higher fat content than the solitary controls, and it has now been found that the situation in the resulting freshly emerged adults is reversed, with the adults from crowded cultures having less fat. These adults, however, had a higher glycogen content. Experiments have shown that adults from crowded cultures consume less food and yet live a longer time than their solitary counterparts. These results suggest a difference in the utilization of the food reserves, and further analyses to elucidate this problem are being carried out. Eighty per cent of the daily total of food consumed by *P. gamma* was taken at dusk and dawn, when the moths were most active.

Observations on oviposition periods and fecundity are in progress. The eggs laid by adults from crowded larval cultures were the lighter in weight.

The population density of the adults was found to produce marked effects. As the number of pairs of moths per cage was increased, the mean total eggs laid per female also increased. A large part of the maximum increase observed could be obtained by increasing the number of pairs from 1 to 2, when the total eggs laid per female rose by 70 per cent. It was also found that the pre-oviposition time was reduced by increasing the number of pairs such that cages containing 8 pairs took less than half the time taken by single pairs. Other aspects involving longevity and the egg-laying rate are being investigated.

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Forest Soil Investigations

(P. W. Murphy)

During the present year experimental investigations have been concerned with the fauna associated with freshly fallen tree litter. There is increasing evidence of a sequential pattern in organic-matter decomposition with a succession of fauna and flora associated with it. Present studies are directed to this aspect in order to determine whether in fact successional biological phases occur in decaying leaves, and if so the species associated with each stage. A major problem in these investigations is the difficulty of ascertaining the age of leaves used as experimental material. A partial solution would be to collect recently fallen leaves, but the difficulty here is to maintain these in conditions comparable to those occurring in the natural milieu. The possibility of marking leaves with a radio-active isotope is being explored, and a pilot experiment using this technique was commenced in the autumn of the present year. Beech leaves were marked on the trees with an artists' oil-colour to which had been added tantalum 182. Preliminary results suggest that this technique is a promising means for recovering leaves of known age, but the effect of the isotope on the living inhabitants of the leaves has yet to be ascertained.

A study of predators of cysts and adults of *Heterodera cruciferae* was made with C. C. Doncaster of the Nematology Department. Field observations of rape seedlings in a plot in which *H. cruciferae* had been cultured for about seven years suggested that the nematode population was being reduced by unknown predators. Using a laboratory culture technique, it was found that certain members of the soil meiofauna, especially the springtail *Onychiurus armatus*, fed upon cysts and adults of *H. cruciferae* and other nematodes. The results of this investigation will be published shortly. This sintered-glass culture cell was also demonstrated at a Conversazione of the London branch of the Institute of Biology.

Insect Pests at Rothamsted and Woburn

(R. A. French and K. Mellanby)

Outbreaks of insects which might cause damage have been investigated on the farms on experimental and non-experimental crops; where it seemed possible that experimental yields would be affected by insect attack, this was reported as early as possible to the scientific worker concerned. No really damaging infestations occurred during 1956. Frit fly did some damage to oats, particularly in Pastures, and a very high population of adults emerged in the granary after harvest. Experimental potatoes in Great Knott III were endangered by wireworm (1,000,000 to the acre), but aldrin applied by the farm staff gave good control. Lucerne in Great Harpenden I was seriously attacked in the early stages by millipedes. The damage was particularly noticeable because the cold, dry weather slowed the growth of the crop. It is hoped to continue and extend this survey next year.

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Insects and Climate

Effects of climatic factors on metabolism and behaviour (K. Mellanby and R. A. French)

Plots of brussels sprouts were grown on Bones Close and Furzefield in positions where substantial microclimatic differences were expected to occur. Temperature records were kept by the Physics Department. The growth of large cabbage white caterpillars was investigated on these plots. The weather during the experimental period (August and September 1956) was such as to minimize microclimatic differences, and the results obtained from the insects were inconclusive. Further experiments are planned in the same locations.

Laboratory experiments on mealworms and other insects have been continued, partly to provide material for the analyses described below. Factors influencing activity have been investigated (a paper was read to the Association for the Study of Animal Behaviour in October). It has also been shown that changes in diet may substantially alter the position of the optimum temperature for development, and may extend the range over which survival is possible.

Fat Metabolism and Temperature

(L. M. Cherry and K. Mellanby)

Much time has been spent on improving techniques for extracting fat from insects and for determining its iodine number and other characteristics. It appears that imperfections in methods must substantially reduce the value of much of the earlier work on insect fat. Work is proceeding on the analysis of fats from insects reared at, or acclimatized to, different temperatures, and also on the effects of differences in diets on the composition of fat reserves.