ROTHAMSTED RESEARCH

Report for 1950

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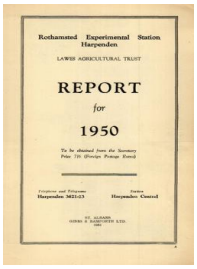

Bee Department

C. G. Butler

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BEE DEPARTMENT

By C. G. Butler

General

During 1950 the work of the department has proceeded along the lines which have been outlined in previous reports. Members of the department have continued to serve on various Committees and have taken part in a number of Short Courses for beekeepers. Two Extension Courses, arranged by London University and by Birmingham University, were conducted by Dr. C. G. Butler.

Mr. M. Hassanein, a temporary worker, returned to Egypt after obtaining his Ph.D. degree and Miss G. R. Wykes, after completing her thesis for this degree, has obtained a grant from the Agricultural Research Council to enable her to continue her work on nectar for a further year before she returns to Australia.

Miss M. Ryle and Miss E. Tyndale-Biscoe have joined the scientific staff and are extending the work on the relationship between nectar secretion and bee activity which was commenced by Miss Wykes.

The new building at Rothamsted Lodge, consisting of four small laboratories, workshop, honey-house and storage shed, was completed during the year. Besides relieving the congestion in the department considerably, it is providing greatly improved facilities both for research work and for the management of the bees. The home apiary and the old field laboratory and workshop have been vacated. As well as providing better facilities for our work this move has had the desirable result of bringing the apiary staff and the research staff together at Rothamsted Lodge.

Behaviour of the Honeybee in the Field

C. R. Ribbands has now completed his research on the effective flight range of the honeybee. This work was done by comparing the gains or losses in weight of stocks of bees sited right on crops with those of groups of stocks sited three-eighths and three-quarters of a mile away from the same crops. The principal crops on which this work was done were apple, lime and heather, and on these crops experiments were carried out during 1949 and were repeated exactly during 1950. These, together with two additional experiments, produced data which showed that the effect of increasing the distance between the stocks of bees and the crops on which they worked was considerable and consistently detrimental to honey production, but that the magnitude of this effect varied considerably.

Colony net gains are the surplus left over after the requirements of the colony for immediate sustenance have been met. As these requirements are considerable and similar, irrespective of distance from the crop, the effect of distance upon colony net gains is much greater than its effect upon the quantity of forage brought into the hive. Similarly, the effect of distance upon honey yield to the beekeeper is even greater than its effect upon colony net gains, because a large and similar quantity of honey must be left to each colony for its use during the winter.

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Some of the effects of the distance between the stocks and the crops that were observed could be attributed to increases in the length of time that it took the bees to fly between their hives and the crops, but most of them were mainly due to unfavourable weather conditions for bee activity in the field.

The results illustrate a disadvantage of the practice of placing a large number of colonies of bees in a single apiary. The results also suggest that when stocks of bees are placed in orchards for pollination purposes it may prove to be more satisfactory, under some conditions, to scatter them to the maximum extent that is convenient, rather than to place them in compact groups.

Ribbands has also demonstrated the fact that foraging honeybees are unable to communicate to other bees the colour or colours associated with a source of food that they have discovered. Butler has similarly shown that bees cannot inform other bees of patterns associated with sources of food. These results are in contradiction to the conclusions reached by J. Francon ("The Mind of the Bees," 1939, translated by H. Eltringham: Methuen, London), which were clearly based on unsatisfactory data.

Following on her exploratory field experiments carried out during 1949, Miss Wykes designed a series of laboratory experiments to determine whether honeybees exhibit any selective behaviour when offered equal volumes of solutions of the same concentration in any one experiment, but containing different constituent sugars. The results of these experiments show that the different sugars that were used are not all equally attractive to honeybees, as consistent preferences were exhibited for solutions of certain single or mixed sugars. These results are in complete agreement with those obtained in the field experiments of 1949.

It was found that the relative preference of the bees for certain sugars varies with different concentrations of the solutions. The preference exhibited by the bees in all experiments for solutions containing equal proportions of sucrose, glucose, and fructose, is unexpectedly high when considered in relation to the relative preferences shown by bees for other solutions of sugars. This result is probably of biological significance since nectar, the natural source of carbohydrate for the bee, usually consists of a mixture of sucrose, glucose, and fructose.

An investigation was carried out on the behaviour of honeybees, bumblebees and hover-flies when they were seeking food from sunflowers (Butler, Carlisle, Simpson and Tyndale-Biscoe), but the data obtained have not yet been fully analyzed.

Bee Breeding and Strain Trials

A further development in the technique of instrumental insemination of queen honeybees was made during 1950, and Butler (120) has described a new type of syringe tip which enables the syringe itself to be used as a probe. This new type of tip does away with the necessity of using a separate probe and when used in conjunction with a new type of diaphragm syringe that has been designed by Mr. R. Jarvis, of Rowlands Castle, Hants, obviates the need for a syringe holder. This new type of syringe can be held in the hand throughout the operation and is much easier to insert into the queen than previous types of syringe, thus reducing both the

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length of time required for this operation and also the likelihood of damage being done to the queen. It is confidently anticipated that the use of this syringe will result in a higher percentage of successful results being obtained. Preliminary results have been very promising.

One of the problems connected with instrumental insemination is that in order to obtain results similar to those produced by natural mating it has been found to be necessary to inject into the paired oviducts of the queen six times as much semen as she receives in a natural mating. Attempts have been made by Simpson to study the fate of the excess spermatozoa but the work has been hampered by lack of sufficient queens. It is hoped to continue to study this problem during 1951.

An attempt was made by Simpson during 1950 to inseminate queen honeybees with semen taken from their own drone offspring. Since the drone honeybee is a haploid organism, deriving his genetic characters only from his mother, this procedure would be equivalent to self-fertilization in plants and therefore very useful when attempting to breed pure strains of bees and also in genetical studies. The process is, however, somewhat tedious and involves stimulating the virgin queen to produce eggs by means of the carbon dioxide treatment (introduced by Mackensen (1940)), rearing the drones that are produced from these eggs and finally inseminating the queen with semen taken from them. This last stage in the process has so far not been completed on account of the difficulty of introducing semen into the paired oviduct because of the accumulation of eggs in the latter in a laying queen. It is possible, however, that this difficulty may be overcome by caging the queens for some time before attempting to inseminate them, or in some other way getting rid of any eggs that are occupying the lower parts of the oviducts.

During 1950 a number of queens were, as in previous seasons, successfully inseminated instrumentally by Simpson, Carlisle and Butler, and our breeding stock was maintained in a pure state in this way.

Attempts were also made during the summer of 1950 to obtain pure matings of three different strains of bees in mating apiaries in which only drones of the same strains as the queens being mated were maintained. Work is now in progress (Carlisle and Butler) in an attempt to distinguish those queens which have mated with the desired drones by studying the biometrics of their offspring and comparing these with the biometrical measurements of offspring of queens of these strains which have been instrumentally inseminated with semen taken from drones of the same strains.

Nectar Secretion

As mentioned earlier in this report experimental data have been obtained which suggest that honeybees have decided preferences for solutions of certain sugars in certain proportions. When these results were considered in relation to the occurrence of sugars in nectars and selection by bees of nectars in the field, it was found that few analyses of the constituent sugars in different nectar had been made, chiefly, no doubt, on account of the difficulty of obtaining large enough samples, and no useful conclusions could be reached.

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Miss Wykes, therefore, decided to make a survey of the sugars which occur in samples of nectar from the flowers of a large number of species of plants, using the technique of paper partition chromatography for the analyses. Sucrose, glucose and fructose are the only major constituents of the nectars investigated, but maltose and two sugars of low RF values which appear to correspond to melibiose and raffinose respectively, occur in small proportions in certain nectars.

Preliminary work has also been done in connection with the quantitative determination of the individual nectar sugars separated on the chromatograms.

Feeding of Honeybee Colonies

J. Simpson has during 1949 and 1950 been investigating the composition of the stores of "honey" resulting from the autumn feeding of sugar syrup to colonies of bees. Analyses of the proportions of water and of sucrose have been made on samples of stores resulting from the feeding of strong (66 per cent sucrose) and weak (38 per cent sucrose) syrup. From the results so far available it appears that the water content of these samples are about normal but that the sucrose contents are, as indicated by other workers, much higher than in natural honeys.

C. G. Butler and Miss E. Carlisle continued the experiments carried out in previous years on the effectiveness of the feeding of various pollen supplements on the rate of build up of colony strength in the spring. It has been shown that the addition of a small quantity of yeast to soya-bean flour makes the latter much more efficient in this respect than soya-bean flour alone or soya-bean flour pollen mixtures. It appears that the yeast enables the bees to make better use of the soya-bean flour. It is hoped to continue this work during 1951.

C. R. Ribbands published during the year a paper on the autumn feeding of honeybee colonies (121) which indicates that it is more economical to feed concentrated sugar syrup (66 per cent sugar) than more dilute (38 per cent sugar) syrup.

Adult Bee Diseases

M. Hassanein, who has now returned to Egypt, continued his work on the influence of Nosema and Amoeba disease upon the behaviour of infected queen and worker honeybees.

It is hoped that it will soon be possible to appoint someone to work on bee paralysis and other adult bee diseases.

Brood Diseases

Mrs. Schreiner has now completed two years work on European Foul Brood. She has shown that Professor Burri's hypothesis that *Bacillus pluton* is a pathogenic form of *B. eurydice* is untenable.

During the course of this work she has developed a technique for testing the pathogenicity of various organisms concerned with European Foul Brood on the honeybee larvae and obtaining a definite result within forty-eight hours. She has at the same time attempted to culture *Bacillus pluton* in the laboratory, having previously shown that the media suggested by various workers for this

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purpose are useless, and has obtained some important data which may result in the elaboration of a suitable medium for this purpose in the near futre.

Although it is virtually certain that *Bacillus pluton* is the organism that is responsible for the disease known as European Foul Brood this cannot definitely be proven until the organism has been cultured in the laboratory and innoculation tests have been made with pure cultures. It is also necessary to discover the life history of the causative organism before it will be possible to suggest rational methods of combating this disease.

Mrs. Schreiner is shortly leaving Britain to return home to South Africa. It is hoped that it will soon be possible to find a suitably qualified person to continue her work on this important subject.

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