ROTHAMSTED RESEARCH

Report for 1948

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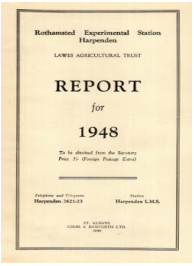

Bee Department

C. G. Butler

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BEE DEPARTMENT

By C. G. Butler

General

Lectures have again been given by various members of the Department to Scientific Societies, Beekeepers' Associations and other organizations. A discourse on "Bee Behaviour" (125, 126) was given by Dr. C. G. Butler at the Royal Institution, and he also conducted a short course of extra-mural lectures at London University. A book entitled "An Introduction to the Sense Physiology and Behaviour of the Honeybee" has been written by Dr. Butler (127). A Leaflet describing the use of honeybees as pollinating agents in orchards (123) has been prepared for the Ministry of Agriculture and Fisheries, and also a Bulletin on "Bee-Hives" (128). Members of the Department have served on various committees such as the Minister's Bee Disease Advisory Committee, the British Standards Institute Sub-Committee for the standardization of beekeeping equipment, and the British Beekeepers' Association Research Committee.

Bee Behaviour

Considerable advances have been made in the study of the principles underlying the foraging behaviour of the honeybee and a paper describing some of the results of Mr. C. R. Ribband's work on this subject has been accepted for publication (131). Studies designed to determine the usual sequence of foraging duties, if any such sequence exists, and the extent to which these duties are determined by the requirements of the colony and the previous conditioning of the individual, have been commenced by Mr. Ribbands, but have been impeded by the exceptionally adverse weather conditions experienced during 1948. These studies will be continued during 1949. So far the results appear to allow of the tentative conclusion that the effect of foraging distance upon honey yield in Britain has often been seriously underestimated.

In further work carried out by Mr. Ribbands a study is being made of the modification of the behaviour of honeybees that have been subjected to anæsthesia. Bees were captured whilst gathering pollen and nectar from sainfoin or cornflower, and marked after anæsthesia with either chloroform, carbon dioxide, or nitrogen. After chloroform anæsthesia the marked bees returned to the same crops (indicating that their memory was unimpaired) and collected both pollen and nectar as before: after carbon dioxide or nitrogen anæsthesia, however, the bees, although they also returned to the same crops, changed their foraging habits and collected nectar only. Further investigations have shown that carbon dioxide anæsthesia of newly-emerged bees induces them to forage at an early age and eliminates their brood rearing activities. The effects of the carbon dioxide or nitrogen treatment are similar in many respects to an artificial ageing of the bees, but recent work indicates that anæsthesia with these substances does not produce a complete parallel. The theoretical importance of these results lies in the fact that the treatments change bee behaviour from one normal condition to another and, perhaps, indicate the physiological basis of the

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behaviour patterns. A paper embodying these results is being prepared.

Work is also being commenced by Dr. Butler in an endeavour to determine the physiological nature of the behaviour of worker honeybees both in the hive and in the field, and also the development of the nubile and egg laying conditions of the queen honeybee, and of the sexual development of the drones.

Dr. Butler has made an experimental study of the behaviour of worker honeybees when seeking the entrance to their hive, and a paper on this subject which throws further light on the psychology of the bee is being prepared for publication. He has also conducted a series of experiments in an attempt to determine how the male of a solitary bee, *Andrena flavipes*, finds and recognises the female.

Pollen Trapping

The study of pollen collection by honeybee colonies was continued during 1948 by Mr. J. Simpson by means of pollen traps. Previous work has shown that over the whole season colonies in the same apiary sometimes collect very different amounts of pollen from any one source. During 1948 day to day variations of this kind were investigated in the hope of finding some explanation. This aspect of the work is not yet complete and will have to be continued.

Owing to the persistently bad weather, the records of pollen catches during the summer of 1948 were very patchy, little or no pollen being collected for considerable periods. An interesting feature was that during this season, which was notable for the failure of the more important nectar producing plants in the Harpenden district to yield nectar, the collection of pollen from these same sources was very small, and that the bulk of the pollen collected, sometimes in considerable quantity, was obtained by the bees from plants, such as the field poppy (*Papaver rhœas*) which do not produce any nectar.

The Possible Harmful Effect of Various Herbicides and Insecticides on Honeybees

Mr. G. D. Glynne-Jones has, with the co-operation of the Beekeeping Advisory Section of the National Agricultural Advisory Service, made a survey throughout England and Wales in an attempt to determine the extent to which the employment of herbicides and insecticides in the field is proving harmful to honeybees. Beekeepers were asked to report, giving the fullest possible details and submitting samples of the bees, all supposed cases of losses of honeybees by poisoning. Of sixty-three cases of bees reported, thirty were, on the evidence available, considered to have been due to poisoning, the majority of these being directly attributable to the application of arsenical sprays to fruit trees when in flower. Some evidence was also obtained which suggests that the use of D.D.T. in orchard sprays can also be harmful to bees, but no definite conclusions on this point can be drawn from the data available. None of the losses of bees reported could be attributable to the use of herbicides.

The more serious cases of bee poisoning occurred during April and May and were largely confined to the fruit-growing areas of Cambridgeshire and Essex.

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Mr. Glynne-Jones also conducted an experiment on a field scale in order to investigate the possible harmful effects of D.N.O.C. on foraging bees when this substance is used to kill charlock when this plant is in flower. Observations made on colonies of bees in the field itself showed that some foraging bees were killed whilst the spraying was in progress but that no damage was done either to the "house bees" or to their brood. It would appear to be a wise precaution in order to minimise losses of honeybees to recommend that farmers who intend to have charlock sprayed whilst it is in flower should warn neighbouring beekeepers to confine their bees to their hives whilst the spraying operations are actually in progress. The speed with which the sprayed charlock flowers wilt after treatment with D.N.O.C. appears sufficient to deter the bees from returning to them and thus becoming poisoned.

The results of the investigations made by Mr. Way and Miss Synge on the possible harmful effects of D.D.T. and Benzene Hexachloride on bees has now been published (133). It was concluded that although D.D.T. can be shown to be toxic in the laboratory it appears to have no harmful effects in the field even when applied to open blossom. Benzene Hexachloride, on the other hand, proved to be highly toxic to bees when applied to open blossom.

The Reactions of a Colony of Honeybees to its Physical Environment, particularly during the Winter Months

Mr. J. Simpson has confirmed that when a colony of honeybees is subjected to an excessively high temperature the bees collect, and evaporate within the hive, large quantities of water. As the temperature of the air outside the hive falls the temperature within the brood-area is maintained between 32° C.—34° C. by contraction of the cluster of bees resulting in a reduction in surface area, thickening of the insulating shell of the bees and a reduction in the rate of movement of convection currents. Within the temperature range covered by these observations (22° C.—36° C.) the various active movements of the bees forming the cluster such as fanning with the wings and shaking of the body, showed no variation in frequency or intensity sufficient to support the view that extra heat produced by these activities is important in the maintenance of the temperature in the brood-area. The humidity of the atmosphere within the winter cluster formed by a normal colony of bees was investigated over a period of time during which the outside temperature ranged from 0° C.—20° C. When the outside temperature was below 10° C. it was found that the dew-point of the air within the cluster was usually 8° C.—10° C. above that outside the hive, so that the relative humidity of the atmosphere within the brood-area with its temperature of about 33° C. must have been very low. This was confirmed by observation of the absorption or evaporation of water from capillary tubes filled with sulphuric acid of various known concentrations placed within the cluster. Work along these lines is being continued.

Bee Breeding

A start has been made on a programme of work to produce, by means of artificial insemination, sufficient queens of known parentage to head all the Department's experimental colonies. This is

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considered to be most important as it is likely to lead to a considerable reduction in variability between colonies. Comparative trials with a number of different, well-established, strains of bees have been commenced and a strain trial unit has been established in one of the out-apiaries. It is hoped that it will be possible to establish further units not only in the Department's apiaries but also at outside centres in various parts of the country during the next few years. All the queens used in these strain trials are being inseminated instrumentally so that the parentage of their offspring can be guaranteed. Unfortunately bad weather and an outbreak of Nosema disease seriously hampered this work during 1948.

Acarine Disease

Interest has recently been revised in the treatment of Acarine disease by fumigation with the vapour of a burning smoker cartridge impregnated with sulphur. Trials of this treatment have been carried out by Mr. P. S. Milne and members of the N.A.A.S. Bee Advisory Staff on bees of colonies infected with this disease in four apiaries near Harpenden. The colonies used in these trials ranged in size from a small nucleus established from a July cast to full strength colonies. The results that have been obtained are very promising and appear to indicate that this "sulphur" treatment may be a satisfactory and reliable method of treating infected colonies during the active season. Further trials will be carried out during 1949. A short article on the method of preparing the sulphur cartridges and the application of this treatment has been published (129).

Sulphonamide Treatment for American Foul Brood

Further trials of the sulphonamide treatment for A.F.B. were arranged by Mr. Milne during 1948 and the colonies that had been subjected to this treatment in previous years were kept under observation. A recurrence of A.F.B. was confirmed in one of the trial colonies that were treated during 1946, thus providing further evidence that the sulphonamide treatment is not fully reliable and supporting the view expressed in our 1947–48 report that these sulphonamide drugs are unlikely to prove to be of such value in cases of A.F.B. as had been hoped.

European Foul Brood Disease

Miss E. Kops, working jointly with the Bee Department and the Microbiology Department, has been attempting to repeat the observations of Professor R. Burri of the Liebefeld Institute, Berne, on European Foul Brood. According to Burri, E.F.B. is caused by a small bi-pointed coccus, *Bacillus pluton*, which he claims to be a pathogenic dissociant form of *Bacillus eurydice*. He states that *B. eurydice* is a normal symbiont of all adult bees and of all healthy bee larvæ between weaning and pupation. He had grown *eurydice* on ordinary agar and beewort agar and states that after about 24 hours, in most cases, there is an "umwandling" from the short rod *eurydice* to the coccoid *pluton* form. This *pluton* will not multiply on sub-culture, and he has not succeeded in growing *pluton* except as a "dissociation product," as he terms it, of *eurydice*.

Numerous adult bees and larvæ both from healthy colonies and those infected with E.F.B. have been examined culturally and

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microscopically by Miss Kops, but so far no results similar to those of Professor Burri have been observed. Attempts to obtain *eurydice* from healthy larvæ have been unsuccessful, no growth being obtained on ordinary agar plates inoculated with emulsions of such larvæ, but an organism which is apparently *eurydice* has been grown from inocula from healthy adult bees obtained from a number of sources. In no case however, has a culture of this short slender rod changed into *pluton* as seen in smears from diseased larvæ. The large number of *pluton* which can be seen in the microscopic preparations of honeybee larvæ in the early stages of E.F.B. are easily identified, definite in shape and distinctly bipointed. In some cultures the *eurydice* bacilli did appear to shorten to a cocco-bacillus form after a short time, but this form does not appear to be morphologically identical with *B. pluton*. The whole culture did not become coccoid, and no difficulty was experienced with sub-cultures.

Similar results were obtained from attempts to culture *eurydice* and *pluton* from diseased larvæ. This was complicated by the fact that even a small trace of the sporogenic *B. alvei* or *B. orpheus* will spoil a culture since they multiply so rapidly that they swamp a plate in 24 hours. A wide variety of media were used, synthetic media, media prepared from mashed bee larvæ, bee-gut, larval extract, fortified with pollen extracts, yeast and honey. *B. eurydice* was isolated without difficulty from larvæ in the early stages of E.F.B. and appears to be identical with a culture of *eurydice* obtained from Professor Burri. Here too there was sometimes a shortening to a coccoid form still unlike *B. pluton*. No growth of *B. pluton* was observed, except on a soil extract medium. On this medium it did appear the *B. pluton* was growing in its original form without *eurydice* being present at any stage. *B. pluton* could be demonstrated in small colonies of 6–8 organisms at first, and after a few days, some colonies of as many as 60 organisms. It continued in this state of apparent growth for two or three weeks when it disappeared. Two sub-cultures were apparently successful, and a further two doubtful, but by the end of five weeks there was no *pluton* visible on any of the plates. It is hoped to continue this line of work during 1949.

Defective Brood

Mr. Milne noted a widespread incidence of defective brood amongst colonies in the Cotswold area of Gloucestershire during the 1948 season. Infection trials, using material taken from sample combs from these colonies, indicate that the trouble may in some cases be due to a disease with similar characteristics as those that have been described for Sac Brood.

Nosema Disease

Some evidence has been obtained during the last two seasons which indicates that a form of Nosema disease possessing characteristics unlike those previously ascribed to cases of this disease in this country has made its appearance. It appears probable that this form of Nosema which is of a serious nature and often causes premature supersedure, or death, of queen bees and a marked shortening of the life of worker bees, is of American origin. This American

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form of Nosema disease has probably entered this country during the last two or three years either directly with queens imported from the U.S.A., or indirectly via the continent, and is highly infectious. Since this form of Nosema undoubtedly causes serious losses the policy of allowing importation of bees or queens into Britain from the Continent or from Ireland or North America appears to be most unwise. Preliminary trials, carried out by Mr. Hassanein, in attempts to control Nosema by feeding hydrogen peroxide have yielded promising results, and further work along this line will be carried out.

The Feeding of Colonies for Winter

Sugar syrup was fed to two equivalent groups of colonies during late August and early September. Two concentrations of syrup were used—(1) strong, 2 lb. sugar to 1 pint water, (2) weak, 3 lb. sugar to 4 pints water. Each colony was weighed before and after feeding, and the changes in weight were compared with the changes which occurred in a third group of colonies which were not fed at all. 24 lb. of sugar was fed in either strong or weak syrup to each treated colony. Analysis showed that the average net gain in colony weight after feeding with strong syrup was equal to about 95 per cent. of the weight of sugar supplied, whereas after feeding with weak syrup the net gain was only 75 per cent. of the weight of sugar supplied.

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