

ENTOMOLOGY

Laying Worker Honey Bee:
Similarities to the Queen

It is known that in the honey bee community the queen has an influence on the behaviour and the physiology of worker bees¹⁻³. It has been shown that the presence of a queen in a group of worker bees inhibits the development of the ovaries in the workers³. The workers, showing a special behaviour (retinue behaviour) towards their queen, recognize her by special substances. This recognition leads to a 'queenright behaviour', which in turn influences the development of the ovaries. When we take the queen away from such a group, ovarian development in the workers starts, and may result in the so-called laying workers. It seemed to be an interesting point that only a few bees out of a group reached this final stage and it was supposed⁴ that perhaps these bees in turn would have an influence on the other bees.

It has been reported that, in a queenless colony, worker bees can evoke a retinue behaviour in other workers similar to that evoked by the queen^{5,6}.

These considerations induced us to study the laying workers more closely. In 6 experimental cages, each containing 50 newly emerged worker bees, a laying worker taken from a queenless observation hive was introduced. This laying worker could be recognized by a paint mark. The bees were provided with water and a feeder containing a sugar-candy and pollen mixture. At regular intervals, during the renewal of the food and the drinking water, the behaviour of the workers towards the marked bee was studied. In all cases the laying worker evoked a distinct retinue behaviour in the workers.

When after 14 days the bees were killed and examined for ovarian development, the cages with a laying worker showed an inhibition of ovarian development in comparison with controls (Table 1).

| Laying worker added to the cage | | Controls | |
|---------------------------------|-------------------------|----------|-------------------------|
| Cage No. | Ovarial development (%) | Cage No. | Ovarial development (%) |
| 1 | 12.0 | 1 | 25.1 |
| 2 | 16.9 | 2 | 27.0 |
| 3 | 17.6 | 3 | 27.5 |
| 4 | 19.9 | 4 | 28.0 |
| 5 | 20.0 | 5 | 30.3 |
| 6 | 25.2* | 6 | 30.8 |
| mean | 18.6 | mean | 28.1 |

* Laying worker died after 4 days.

In a second experiment we compared the inhibitory action of an extract of bees with highly developed ovaries with an extract of bees with undeveloped ones. For this purpose the ovaries of bees of a queenless group were examined. After division into an undeveloped, a poorly and medium developed, and a highly developed group, the first and the last group of bees were extracted in acetone by Soxhlet extraction for 6 hours. Fifty bees were used for each of the extracts.

Extracted dead young worker bees were impregnated with these extracts. A bee impregnated with the 'highly developed' extract was placed in each of 6 cages containing 50 young bees and a bee impregnated with the 'undeveloped' extract in each of 6 control cages. Every 2 days we removed the impregnated object and replaced it with a new one.

At the moment of removal of the impregnated bees observations were made about retinue behaviour. In all cases the 'highly developed' extract evoked retinue behaviour, whereas this was never observed in the control cages.

After 14 days the bees were killed and the ovarian development was determined. Table 2 shows that the 'highly developed' extract inhibited ovarian development.

Table 2

| Extract of bees with highly developed ovaries | | Extract of bees with undeveloped ovaries | |
|---|-------------------------|--|-------------------------|
| Cage No. | Ovarial development (%) | Cage No. | Ovarial development (%) |
| 1 | 17.1 | 1 | 37.8 |
| 2 | 14.0 | 2 | 34.2 |
| 3 | 14.0 | 3 | 24.7 |
| 4 | 12.0 | 4 | 33.9 |
| 5 | 15.0 | 5 | 23.0 |
| 6 | 9.6 | 6 | 34.2 |
| mean | 13.6 | mean | 33.0 |

Apart from the production of eggs a laying worker obviously resembles the queen in releasing retinue behaviour and in inhibiting ovarian development in young bees under experimental conditions. Just as in the queen, this influence of the laying worker is based on the production of substances that are perceived by the other bees.

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Metabolic Effects of the Corpus Allatum
Hormone in the Desert Locust, *Schistocerca gregaria*

SOME thirty years ago, Wigglesworth¹ first demonstrated that yolk deposition in insect oocytes is controlled by the corpus allatum hormone. Since then, the hormonal control of vitellogenesis has been complicated by some experiments, which suggests that the corpus allatum hormone also has metabolic effects. Allatectomy leads to the accumulation of lipid and the hypertrophy of the fat body in a number of insects²⁻⁶. From such evidence, Pfeiffer² advanced the hypothesis that the corpus allatum controls vitellogenesis by releasing a 'metabolic hormone' that in some way regulates the mobilization of precursor materials from the fat body. This hypothesis has always suffered from the serious objection that ovariectomy does not lead to the expected accumulation of yolk precursor materials in the fat body^{2,6}.

A second hypothesis has been put forward by Doane⁷, based on her observations of the hypertrophied fat body of female-sterile mutants of *Drosophila melanogaster*. In such mutants, the corpus allatum is normal in function, since wild-type ovaries implanted into mutant female flies develop eggs normally; the lethality in the mutant forms resides autonomously in the ovaries themselves. Doane therefore suggested: (a) that an 'ovarian hormone' is released by active ovaries in a normal fly, the function of the hormone being to regulate the utilization of stored lipids in the fat body; (b) that the action of the ovarian hormone on the fat body is independent of any analogous action of the metabolic hormone of Pfeiffer, although its release may be indirectly controlled by the gonadotrophic activity of the corpus allatum.

A fresh approach to this problem was attempted when preliminary observations indicated that allatectomized male desert locusts were inactive.

An electron microscope study of the fat body of allatectomized male desert locusts has shown that large deposits of glycogen and lipid accumulate in the fat body. The accumulation of lipid was confirmed by chloroform-extraction of whole locusts. Implantation of active corpora allata into previously allatectomized locusts alleviated this condition.

Spontaneous locomotor activity of adult male locusts was determined by the method of Brown and Unwin⁸. It was found that after allatectomy there was persistent