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Temporal decline in attractiveness of honeybee queen tracks

A BODY or surface (such as that of a worker bee or a cage) that has been in contact with a honeybee queen becomes attractive to worker bees^{1–3} due to contamination with queen pheromones^{3,4}. Little information is available about the durability of those pheromones, apart from Butler's report that 30 min after removal of the queen a cage becomes less attractive to the workers, and loses its attractiveness entirely after a further hour¹. I report here experimental evidence of a temporal decline in the attractiveness of tracks left on a waxed surface by a queen.

I monitored the accumulation of worker bees on a wire-gause cage which contained a queen^{4,5} or had been marked with her tracks on the inner surface. To achieve experimental conditions as near as possible to those inside a hive, the accumulation of bees was determined by weighing the cage with them on it. The cage was suspended from one of the arms of a balance and was let down, through a hole in the ceiling of the hive, over the brood chamber of the test colony. It was possible to put the queen into the cage and remove her from it without taking the cage from the hole. The cage was left over the brood chamber during the test, and the worker bees had easy access to it.

The cages used were covered with wax, and before the experiments they were kept in the hive of the test colony, which had a mated laying queen.

The bees that gathered on the cage containing a live mated queen were weighed. Then the queen was removed and weighing was repeated at 1-min intervals. The data obtained were used to give the relative attractiveness of queen tracks as a function of time (Fig. 1): it demonstrates a clear decline.

My results show that queen tracks can contain at least one pheromone that loses its effectiveness quite quickly, whereas the best known pure pheromone (9-oxodecenoic acid) has been reported¹ to remain detectably active in very small quantities for 7 yr.

The decline of attractiveness may occur either through volatilisation of the pheromone or in some other way. If queen tracks are assumed to form a thin film over a surface, the pheromone molecules in the film being dispersed far enough one from another (and consequently having an equal chance to leave the surface), the density of the molecules in the air near the surface (due to volatilisation) can be shown⁶ to change by the factor $\exp(-t/\tau)$ where t is time and τ is a positive parameter independent of t . The attractiveness of queen tracks can be expected to change in the same way. As Fig. 1 shows, the experimental data agree with this. Therefore the temporal change in attractiveness of queen tracks to worker bees is determined by τ ($27.9 \leq \tau \leq 29.2$ min for 95% confidence level). The half-life is 19.3–20.3 min.

Some evidence for a similar rate of loss of attractiveness of queen tracks is provided by Velthuis's observations of interactions between a group of queenless worker bees and "substitute queens" (workers bearing queen pheromones on their bodies). The attractiveness of the substitute queens lasted 5–45 min, the mean duration being 15 min (ref. 3).

Thus queen tracks are attractive to workers (and therefore are perceived by them) for sufficient time to have a possible influence on the behaviour of the workers and the state of the

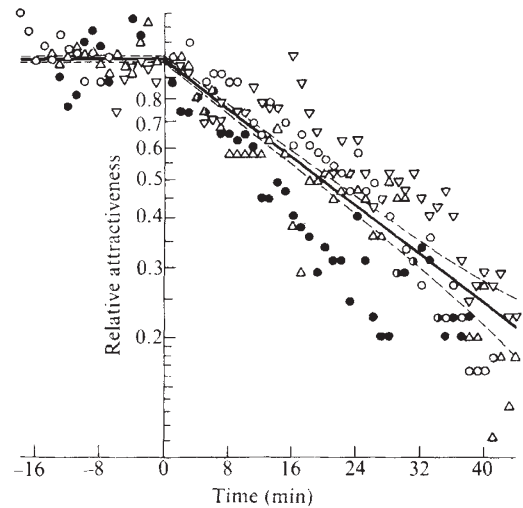


Fig. 1 Relative attractiveness to worker bees of a caged live mated queen (time < 0) and queen tracks left on the inner surface of the cage (time > 0). The different symbols correspond to data collected in four separate tests.

colony. On the other hand, the tracks lose their attractiveness (and cease to be perceived) sufficiently quickly to account for the rapid onset of queenless behaviour in a colony deprived of its queen.

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The living coelacanth *Latimeria chalumnae* does not have a cloaca

POSSESSION of a cloaca is presumed to be a primitive vertebrate character that has been lost independently four times—in lampreys, chimaeras, actinopterygians and eutherian mammals—as the adult morphology of the urinary-genital-rectal openings is different in each group. Hagfishes, sharks, lungfishes, amphibians, reptiles, birds, monotremes, marsupials and *Aplodontia rufa* all possess a cloaca¹. Millot and Anthony² stated that the male *Latimeria* has a true cloaca whereas the female has a rectal opening separate from a common urinary-genital opening. We report here evidence that neither male nor female *Latimeria chalumnae* has a cloaca.

Male and female specimens of *Latimeria* were dissected to follow the digestive, urinary and reproductive tracts to their posterior openings. A plastic strip was inserted into the urethral