Reports

Do the Nurse Honey Bees Recognize the Sex of the Larvae?

The queen in the honey-bee colony lays two types of eggs, fertilized and unfertilized. Usually the fertilized eggs are laid in the smaller (worker) cells or in the queen cells and produce either workers or queens. The unfertilized eggs are deposited in larger cells and produce drones. The food which the nurse bees fed to queen larvae is almost devoid of pollen; a little pollen is present in the food of older worker larvae, but the food of older drone larvae contains considerable amounts of pollen.

Planta (*1*) did not find any pollen in the food of older worker larvae. However, the food of drone larvae, over 4 days old, showed a great admixture of pollen grains (15,000 grains in 1 mg of food). On microscopical examination, Haydak and Vivino (*2*) found 9 to 11 grains of pollen per field of vision in the food of older worker larvae, and Haydak (*3*) counted an average of 38 grains in the food of older drone larvae. It appears that the nurse bees differentiate between the drone and the worker larvae. Is the sex of the larvae or is the size of the cells instrumental in this differentiation? Gontarski (*4*) considers that not the cell content (the type of the larvae) but the form and the size of the cells are the stimuli determining the type of food deposited in the cells by the nurse bees.

It is a known fact (*5*) that, when offered only drone combs, the queen will lay fertilized eggs in the drone cells. In the presence of worker combs, the queen begins to lay normally, depositing fertilized eggs in the worker, and unfertilized in the drone, cells. On the basis of this knowledge, the following experiment (*6*) was designed.

In the spring (9 May) two queenright packages were hived on drone combs and drone foundation. The queen started egg laying, and the larvae were fed normally. The food was then taken from the cells that contained the older larvae. The lower walls of the cells were destroyed, the larvae were removed, and the food was taken out with the help of a royal-jelly spoon. Usually five vials were used, the food of ten cells being placed in each. The content of each vial was thoroughly mixed. Five samples were taken from each vial, and five readings were made on each sample, under an objective lens of $\times 44$ magnification. The average pollen count per field of vision was 12 grains.

The larvae were sealed by the bees, with worker-shape cappings, and worker pupae were found in the cells. Ten days later a second set of samples was taken, from the drone cells that contained worker larvae, and the average pollen count was three grains of pollen per field of vision. At this time, about half of the drone combs were taken out, and worker combs were added to the colonies. When older worker larvae were found in the worker cells, the samples of food of older larvae were taken from the worker cells and from the drone cells containing worker larvae. The average pollen count was four grains of pollen for the food of older worker larvae from the drone cells and five grains of pollen for that from the worker cells containing older worker larvae. When the colony started to rear drone larvae in the drone combs, the samples of food from the cells that contained older drone larvae averaged 16 grains per field of vision.

The queens were removed from the colonies. When laying workers appeared, samples of the food from the drone cells that contained older drone larvae were taken again. The average count was six grains of pollen per field of vision. The food from the queen cells built over the drone larvae (which changed to drone pupae in the constant temperature chamber) contained 0.3 grain of pollen per field of vision.

The results seem to indicate that, at the beginning, the bees hesitated somewhat in recognizing the sex of the larvae in the drone cells, thus supplying the older worker larvae with a larger amount of pollen. However, later, they were giving the food for worker larvae, containing less pollen, to the older worker larvae reared in both the drone and the worker cells. When the unfertilized eggs were laid in the drone cells, the bees recognized the drone larvae and fed the older larvae a ration that contained increased amounts of pollen, as is done normally. This would indicate that the nurse bees, under normal conditions, recognized the sex of the larvae irrespective of the size of the cells.

An entirely different picture was observed when the colonies became hopelessly queenless and the laying workers began their activity. In this case the older drone larvae in the drone cells were fed the food containing less pollen, which is normally offered to the older worker larvae. Moreover, the drone larvae in the queen cells received the royal jelly which is given to normal queen larvae. Thus it appears that, in a laying workers' colony, the bees did not differentiate with respect to the sex of the larvae. The cause of this phenomenon is difficult to explain at present.

From these findings it appears that, in the queenright colonies, the nurse bees recognize the sex of the larvae and feed the older larvae of both sexes accordingly. However, in the hopelessly queenless colonies, it seems that the nurse bees feed the older drone larvae as if they were female larvae.

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References and Notes

1. A. Planta, Z. *physiol. Chem. Hoppe-Seyler's* 12, 327 (1888).
2. M. H. Haydak and A. E. Vivino, *Ann. Entomol. Soc. Am.* 43, 361 (1950).
3. M. H. Haydak, *ibid.* 50, 73 (1957).
4. H. Gontarski, *Hess. Biene* 85, 89 (1949).
5. R. A. Grout, *Iowa State Coll. Agr. Expt. Sta. Research Bull. No. 218* (1937).
6. This report is paper No. 3876 in the Scientific Journal Series, Minnesota Agricultural Experiment Station, St. Paul.

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Upstream Bottom Currents in New York Harbor

Analysis of data obtained during the 1952 current surveys in New York Harbor by the Coast and Geodetic Survey reveal the net upstream movement of large volumes of water near the bottom. These results were possible because the accurate determination of the flood and ebb currents, made it possible to calculate the flow of the nontidal or residual currents flowing in the same direction. This report explains the method whereby

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