ENTOMOLOGY

Dance versus smell

Despite its almost universal acceptance, the dance language of the bee is now coming in for some intensified reexamination

by Jay Chamblin

Before Dr. Karl von Frisch interpreted the dance language of bees, the phenomenon was regarded as a curious display of unformulated struggles and waggles.

That a honeybee could communicate precise information about the distance and direction to a food source by means of a fantastically stylized, ritualistic behavior pattern, was so novel and somehow beautiful an idea that it has become one of the fondest examples cited by behaviorists to illuminate the fascinating subtlety of nature.

The symbolic value of the bee dance has been given much credence over the past 30 years owing to the reproducibility of von Frisch's research.

But the intriguing notion that such sublime purpose may operate beneath so arbitrary appearing behavior may have led scientists into an unscientific, uncritical acceptance of the theory.

There is a strong challenge to the language hypothesis in a series of experiments reported in the April 4 issue of SCIENCE. Three scientists have produced results inconsonant with those predicted by the theory. The researchers are Drs. Adrian M. Wenner, University of California; Patrick H. Wells of Occidental College, Los Angeles, and Dennis L. Johnson of the U.S. Air Force Academy, all of whom know well the seminal character of von Frisch's work. They found it elegantly simple and so easy to repeat that its limitations had not before been adequately challenged.

By introducing controls not incorporated in earlier studies, the experimenters tested the old assumptions against three concepts about information transference in beehives: odor accumulation in the hive, attractiveness of scent-gland secretions and a hypothesis which predicts that the foraging patterns of bees in their search for nectar depends primarily on smell.

Bees bring back to the hive the odors of the flowers they have been feeding upon, causing an accumulation of odors which may trigger a kind of involuntary recruitment among the workers. After the first few bees discover a new food source, an increasing number of bees appear, until a stream of workers establish a busy, efficient shuttle to and from the hive. Dr. Wenner and his colleagues believe that it is not the dance which is dispatching foraging directions, but probably the bee's own innate response to an olfactory stimulus in the presence of a sufficient concentration of flower odor.

In an experiment to test the odor accumulation hypothesis, 10 individually marked recruiter bees were allowed routinely to visit and return from two dishes filled with clove-scented sugar water placed at a distance on opposite sides of the hive. All non-marked bees arriving at the food dish were classified as recruit bees; as they arrived they were captured so as to prevent their return to the hive, and each succeeding recruit was likewise captured.

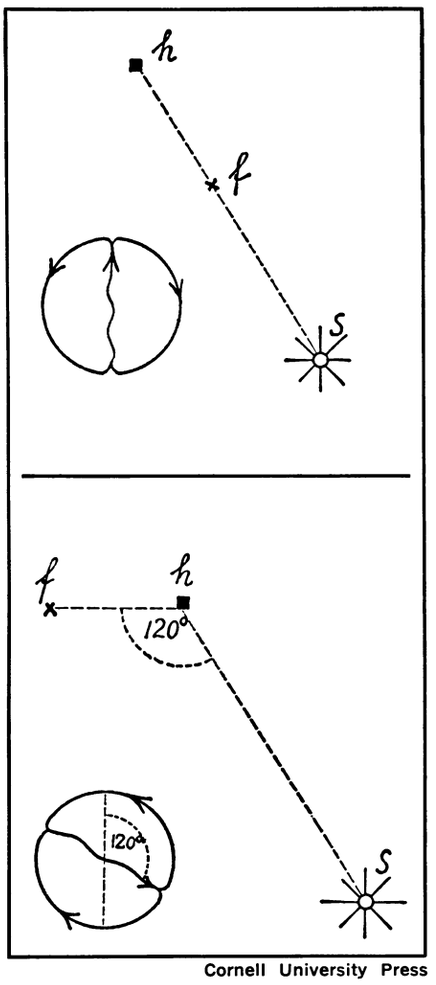
It would be expected from the dance-language rationale that there should be no increase in the number of bees arriving per unit time, because the dancing behavior stops after the initial discovery of a major new food source. Thus, under the von Frisch hypothesis, the 10 marked bees, the only possible messengers, would not be getting word back to the rest of the colony after the initial sortees.

In fact, what happened was that an increasing number of new bees arrived. The experimenters observed that the number of recruits is more reflective of the collective number of trips than of dancing by the marked foragers.

The scientists reasoned that new arrivals readily locate the food source as a direct consequence of scent accumulation within the hive. Further experiments yielded corroborative results. Artificial foods, scented and unscented, were used to demonstrate and validate predictions of recruitment and foraging behavior.

Of the three hypotheses tested, food location by means of the bee's scent glands seems the most doubtful although differing amounts of scent caused different behavior.

Bees are equipped with an evertable gland which secretes an odor thought to attract searching bees. There was a positive association between the amount of scent present in the food and the degree of scent gland exposure. Perhaps the gland is used to compensate for the absence of naturally occurring attractant at a food site.



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Von Frisch's drawing of dance clues from sun (s) and hive (h) to food.

The researchers do not discount the possible role of dancing maneuvers as functional behavior. They confirm the correlation of certain elements in the dance with direction and distance.

Over the years, exhaustive studies clearly show these movements are not random in nature. The angular direction to the food source with respect to the position of the sun is indicated by the angle made by the straight portion of the bee's dance relative to the vertical; the distance to the source by the rate at which the bee wiggles its abdomen. Since this exotic ballet takes place on the vertical wall of a comb in the darkness of the hive, the language hypothesis suggests that hivemates follow the dancer by means of their antennas.

But the three biologists say that the information contributed by the dance "does not appear to contribute" to the gathering of food.

While the dance apparently contributes something to the communication among bees, its importance in relation to the other information sources is now an unknown quantity. ◇