"The Dance Language of Bees"
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Scientists have always found animal communication to be a fascinating topic. The dance language of honey bees was one of the very first to be studied and interpreted. The fact that honey bees are able to accurately annotate the distance and location of a food source to their hive mates through intricate dances was a thrilling discovery.

Despite popular belief, the honey bees' dance language was not just recently discovered. It was first observed and noted by Aristotle as early as 330 B.C. [1] However, it was not studied in-depth until Karl von Frisch, a German professor of zoology, played detective in the mid-1900s. [2] He spent many years studying and interpreting honey bee communication. Along with his students, he dutifully carried out decades of experiments in an attempt to correctly interpret the exact body language bees use to talk to each other. He utilized glass-walled observation hives combined with paint-marked bee foragers to observe their dances. Frisch and his students trained these forager bees to find food sources he strategically chose for his experiment. After the foragers had collected food from these sources, he documented the way in which they communicated the locations to other hive mates. [3] His book, *The Dance Language and Orientation of Bees*, published in 1967, presents his findings from his fifty years of devout research. In 1973, Frisch received the Nobel Prize for his discoveries. [3] His exploration of the dance language of honey bees allowed future generations to grasp the concept and expand on his hypothesis.

Frisch concluded that different dances suggested different distances from food sources. Bees engage in several variations of dance. Bees will perform a round dance, sickle dance, the wag-tail dance, and several transitions between the round dance and wag-tail dance. [4] The two which Frisch studied and described in depth were the round dance and wag-tail dance.

If less than fifty meters from the hive, the forager performs a round dance. The bee flies once or twice in a small, tight circle, and then suddenly switches directions. It continues this motion several times over the honey comb to alert other bees and get them interested. The other hive members are symbolically invited to search the immediate vicinity of the hive for food. This dance is fairly simple, and does not suggest a specific distance or direction. [5]

However, once a food source is more than fifty meters in distance from the hive, the forager utilizes a different tail-wagging dance. A diagram of this resembles a compressed figure-eight, and the bee exhibits tail-wagging dance movements while dancing down the straight part of the design between the two loops. The longer the distance of the straight stretch, the farther away the food source. Amazingly, the bee also communicates how much energy will be required to fly towards the source, and is able to account for wind-resistance as well! [6]

Each bee then averages the many completed dance circuits to determine the most accurate distance to the food source. Interestingly, bees indicate actual flight distance to an object, even if they had to take a detour to get there. [6] If a bee has to go over a rock or building, it subtracts the additional flight distance it had to take to detour. This

information is useful to foraging and scout bees, because they are able to relocate sources, even if new obstacles are placed in the way or original ones are removed.

Not only does this dance indicate distance, but it also tells direction. The bees use the sun as a marker, orienting the angle of their dance to match the direction they must travel in respect to the sun. For example, if a bee rotates the dance forty degrees, the food source is forty degrees from the direction of the sun. This level of language, in itself, is remarkable. However, bee language can get even more complex and detailed. The bee calculates the angle of horizontal orientation and then transposes it to the vertical plane of the honeycomb. A dance lining straight up represents travel in the direction of the sun on the horizontal, while a dance straight down represents travel in the direction opposite the sun. [5] The bee is forced to change the solar angle into a gravitational one. With this detailed way to exchange information, bees successfully communicate the direction and distance of food sources when they are more than fifty meters away from the hive.

These complex dances not only enable the hive to locate and exploit floral resources efficiently, but they are also used to discuss other tasks. The dance language is used to indicate the location of nectar and pollen sources, and is also used to indicate the location of resin sources. The resin is collected, then carried like pollen back to the hive, and used to seal cracks. Life-saving water sources are also communicated by using the dance language. In order to keep the hive between 34.5 and 35.5 Celsius, bees utilize water to cool the beehive in especially hot conditions. [6]

Few animals' communications skills are more complex than honey bees'. Unlike many animal and insect species, they are able to efficiently communicate distances and directions to food sources and hive necessities. They utilize a symbolic language of dance patterns and sounds to effectively find and exploit resources. Bees are truly amazing insects, complex in many ways, and their unique characteristics separate them from any other creature.

End Notes

1. Hadley, Debbie. "Honey Bees—Communication Within the Honey Bee Colony." About.com 29 January 2009 <http://insects.about.com/od/antsbeeswasps/p/honeybeecommun.htm>
2. Kak, Subhash. "The Honey Bee Dance Language Controversy." Louisiana State University. 29 January 2009 <http://www.beesource.com/pov/wenner/mankind1991.htm>
3. Tarpy, David. "The Honey Bee Dance Language." North Carolina Cooperative Extension Service. 29 January 2009 <http://www.cals.ncsu.edu/entomology/apiculture/PDF%20files/1.11.pdf>
4. Dadant & Sons. *The Hive and the Honey Bee*. Carthage, Illinois: Journal Printing Company, 1974.
5. Frisch, Karl fon. 1973. "Decoding the Language of the Bee." University of Munich. 29 January 2009 <http://nobelprize.org/nobel_prizes/medicine/laureates/1973/frisch-lecture.pdf>
6. "Dancing Under a Polarized Sky." Polarization.net 29 January 2009 <http://www.polarization.com/bees/bees.htm>

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