

## **“The Dance Language of the Honey Bee”**

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**Second Place**

BZZZZT! BZZZZT! A honey bee buzzes wildly while walking on the honeycomb. Becoming suddenly quiet, she circles left and downward. Buzzing loudly again, she vigorously shakes herself as she walks upward. Still and silent, the bee turns right and circles back down the honeycomb, completing a figure-eight. She repeats this process several times. You have just witnessed a great mystery of nature, the dance of the honey bee. Please let me explain.

As early as 350 B.C., Aristotle described bees as “shaking themselves off” while other bees closely followed this behavior. [1] In 1788, Fr. Spitzner suggested bees were giving information about a food source to other workers and proposed that the dances conveyed the information. [1, 2, 3] This idea was largely overlooked for over 100 years until the 1920s when Austrian zoologist, Karl von Frisch, while studying ethology (animal behavior), [4] particularly color vision in minnows [5], turned his attention to honey bees. Following his proof that bees use color and odor to find food sources, he began odor experiments to direct bees to specific crops for increased pollination. [2, 6, 7, 8] Trying to understand how bees find food sources, he first wondered if scout bees lead their hive mates to the food. A test proved this was not so. Von Frisch took a bee from the hive, placed her on a sugar tray, and marked her with lacquer. The marked bee flew away and within minutes, the tray was buzzing with several honey bees. Not a one, however, was the bee marked with lacquer. The lacquer bee must have directed them to the food source, but how could this voiceless insect communicate? [2]

After years of careful observations of his glass-sided hive, von Frisch found that the bees he marked would come back to the hive and perform various dances. Sometimes they made the figure-eight dance maneuver described above, but sometimes the returning bee merely ran in alternating circles. [2, 9] What sparked the difference in the dances? Moreover, what did the dances mean?

Running in circles, usually referred to as the Round Dance, means that food is within about 75 meters from the hive, and direction is not given. The closer the food is to the hive, the more rapidly the bee circles. Additionally, the bee slows the speed of her dance to allow for head or tail winds to the food source. [2, 9]

The figure-eight dance, usually referred to as the Waggle Dance, consists of many different elements. It tells not only distance, but direction and sugar content of the food source as well. The number of figure-eights in 15 seconds conveys the distance to the food source. [9, 10] The more intense the waggle, the higher the sugar concentration. [8, 11] If the scout bee turns and waggles straight up on the vertical comb, this means the worker bees must fly directly toward the sun to find the food. If she dances straight down on the comb, this means the bees must fly directly opposite the sun to find flowers. When the food lies at an angle to the vertical line of the sun, the straight waggle portion of the figure-eight dance will be at that same angle and direction, right or left of the sun. [2, 9, 11, 12] But how can direction be accurate if the sun constantly moves? When the foraging bees return to the hive, they adjust the angle of their dance to show the new

position of the food source relative to the sun. When the source is almost gone, the returning bees no longer dance and no new recruits go to that site. [8, 13]

Can the dances still direct the recruits on cloudy days when the sun isn't visible? Because a bee has special compound eyes that see polarized light produced by the sun, even a patch of blue sky allows the bees to know their position relative to the sun and thereby orient themselves to the proper angle to correctly find the nectar sources. The eyes act as a compass, and since they see the entire sky at one time, each flight produces a unique "flicker effect" pattern to their eyes that the scout bee "tells" to the recruits in her dance. In turn, the recruits fly out and orient their bodies in the same direction to produce that same "flicker effect" pattern described by the waggle. [2, 13, 14]

Can the new recruits find the food by the dance alone, or is there another factor? Von Frisch discovered that odor is also important. [7, 8] But how sensitive is a bee's sense of smell, and how necessary is it? Beekeepers say that if a bee stings their bee-suit or a bee is crushed, it can disturb the entire hive. [15, 16] This is because the stinging or crushed bee emits an odor that puts the hive in agitation. Certain scents may provoke a swarm to land, and some beekeepers scent empty hives to lure swarms to settle there. [17] The bees use the scent adhering to the body of dancer bees to locate the nectar source described by the dance. Because, when in von Frisch's experiments the bees had a much harder time finding odorless food than they did food with scent, even when they had watched the scout bee dance, he concluded that odor is needed to help the honey bee find the food source. [7, 80]

This need for odor has created a controversy among bee researchers, but it is beyond the scope of this paper to explain the details. [18, 19, 20] One must remember, however, true research never stops, even when answers are discovered. We will all benefit, bees and humans alike, by remaining open to the mysteries of how the honey bee efficiently does what it has done for thousands of years. May our efforts in bee research be united in studying, protecting and preserving this little marvel of both nature and science.

## Endnotes

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