Dancing Bee Mathematicians

Biologically, it is not the individual honey bee, it is the beehive which is the organism. It is only by their close cooperation that the honey bees survive. An important element in that working together is the collecting of food. To maximize foraging efficiency, worker bees continuously convey to one another where they have found some good blossoms. A returning bee starts to “dance” and quicky becomes the centre of attention by other bees, called followers. If the flowers are less than 50 m away, the returning bee moves in tight circles, waggling its abdomen from side to side. The follower bees then buzz off to look for this promising cache of nectar nearby.

But the worker bee knows more than one dance. When she has found a good supply further away, sometimes more than 5 km, she does a “waggle dance” - a half-circle swing in one direction, followed by a straight run and then a half-circle swing in the other direction. The angle of the straight run in relation to the vertical surface of the hive is the same as the horizontal angle of the blossoms in relation to the sun, e.g., if the bee runs at a 30º angle to the right of the vertical, the other workers will fly 30º to the right of the horizontal direction of the sun. The other bees get an idea how far they need to travel by what they see during the dancing bee’s straight run - the longer the straight run, accompanied by the more abdominal waggles per run, the greater the distance to the source. During the dancing the bee also regurgitates nectar. So when the other bees leave to find this source, they already know what sort of nectar it is, how far away it is and its direction. Scientists don’t pretend to entirely understand how this communication works, saying that odour cues (from pheromones) and sound may also convey information about the location and type of blossoms.

But the honey bee is not only a talented dancer, but also an excellent mathematician. Another of the jobs which the worker bee performs is making the hexagon shaped cells of the honeycomb out of wax. It is estimated that for every 6 to 10 units of honey which a bee consumes, it produces 1 unit of wax, which makes the wax expensive. The bee secretes the wax in small flakes from glands on the underside of its abdomen. The American mathematician Thomas Hales proved the 16th century *honeycomb conjecture* by Jan Brožek. This shows that a hexagonal structure uses the least material to create a lattice of cells within a given volume.

In admitting some of the obstacles in the way of his theory of evolution, Darwin wrote in *Origin of Species*, pages 124, 205: “What shall we say to the instinct which leads the bee to make cells, and which has ... anticipated the discoveries of profound mathematicians?... We hear from mathematicians that bees have ... solved a recondite problem ... made cells ... to hold the greatest amount of honey with the least possible consumption of precious wax”.

Insects in general, and bees in particular, are small of brain and not noted for mathematical ability. We are moved to ask how the bee, only a few weeks after hatching from one of the queen’s eggs, knows how to build a mathematically perfect cell? It was by instinct, it is a built-in ability. But where did this skill come from? Not from the father, the drone, whose only function was to fly in pursuit of the queen to mate with her. Also, the bee’s mother, the queen, had no experience in building cells.

Yet a few weeks from hatching the worker bee has solved a recondite and profound problem which took four centuries for a mathematician to come along who was able to solve it.

And this is only one aspect of this remarkable insect, one of the wonders of Creation - ***Psalm 104:24*** - *“How many are your works, O Lord! In wisdom you made them all; the earth is full of your creatures.”*