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PERSPECTIVE

Honey Comb and its Geometry

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Description

A honeycomb is a mass of hexagonal kaleidoscopic wax cells built by bees (honey bees) to contain their hatchlings and stores of honey and pollen.

Beekeepers generally remove the entire honeycomb to harvest honey. Bumble bees consume around 3.8 kg of honey to secrete 450 g of wax. Beekeepers might return the wax to the hive subsequent to reaping the honey to work on honey outputs. The construction of the comb might be left intact when honey is extracted from it by uncapping and turning in a radiating machine. If the honeycomb is too worn out, the wax can be reused in various ways, including making sheets of brush establishment with hexagonal example. Such establishment sheets permit the honey bees to construct the brush with less exertion, and the hexagonal example of laborer estimated cell bases deters the honey bees from building the bigger robot cells. Fresh, new comb is sometimes sold and used intact as comb honey; it is utilized in cooking or as a sweeting agent.

Broodcomb becomes dull over the long haul, because of void covers and shed larval skins implanted in the cells, close by being strolled over continually by different honey bees, bringing about what is alluded to as a 'travel stain' by beekeepers when seen on casings of comb honey. Honeycomb in the "supers" that are not utilized for brood remains light-hued.

Numerous wasps, especially Polistinae and Vespinae, construct hexagonal prism-packed combs made of paper. Some species of honey bees store honey in nest, thus forming a paper honeycomb. The axes of honeycomb cells are always nearly horizontal, with the open end higher than the back end. The open end of a cell is typically referred to as the top of the cell, while the opposite end is called the bottom. The cells slope slightly upwards, between 9° to 14°, towards the open ends. There are two explanations to prove the reason behind hexagon structure of honeycomb. First, the hexagonal tiling creates a partition with equal-sized cells, while minimizing the total perimeter of the cells. Thus, a hexagonal structure uses the least material to create a lattice of cells within a given volume. A second reason is that the shape simply results from the process of individual bees putting cells together: somewhat analogous to the boundary shapes created in a field of soap bubbles. In support of this, he notes that queen cells, which are constructed singly, are irregular and lumpy with no apparent attempt at efficiency. Geometric efficiency is seen at the close ends of the honeycomb cells. The ends are trihedral (three planes) sections of rhombic dodecahedra, with the dihedral angles of all adjacent surfaces measuring 120°, the angle that minimizes surface area for a given volume. The angle formed by the edges at the pyramidal apex, is known as the tetrahedral angle, and is approximately 109° 28' 16".

The shape of the cells is such that two opposing honeycomb layers nest into each other, with each facet of the closed ends being shared by opposing cells. Individual cells of honey comb do not show geometric perfection, deviations of a few percent from the "perfect" hexagonal shape occur. Between the larger cells of drone comb and the smaller cells of worker comb, or when the bees encounter obstacles, the shapes are often distorted. Bees use their body parts such as antennae, mandibles and legs to manipulate the wax during comb construction, while actively warming the wax. During the construction of hexagonal cells, wax temperature is between 33.6°C to 37.6 °C well below the 104 °F temperature at which wax is assumed to be in liquid state for initiating new comb construction. The body temperature of bees is a factor for regulating an ideal wax temperature for building the comb.

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