**A Bees Brain.**

**Michael Birt**

In spite of their small brain sizes (about one cubic millimetre), honey bees are very smart, with a remarkable ability to learn and recall things very quickly. Their brains are about 20,000 times less massive compared to human brains, and contain less than a million neurons, whilst our human brain has around 80 billion neurons. However, the honey bee brain is actually ten times denser compared to a mammal's brain.

The honey bee brain has an oval shape and is about the size of one sesame seed. The brain is a very sophisticated sensory system which gives them excellent sight and smell abilities. Their small brains are able to make very complicated calculations on distances and optimise route plans for different locations.

How do honeybee brains compare to the fastest supercomputers we have today?

Our fastest computer can process one billion computations per second. A honey bee brain can process one trillion computations per second! But what is the contribution of instinct, pheromones and automatic behaviour? It is true that some bee behaviour is inflexible with instinct guiding their response. But scientists do not fully understand honey bee learning and decision making or what it is that triggers their responses.

 Bees learn from older bees how to do some hive jobs. They also use what they learn from experience to decide how to respond in the future. They utilise symbolic communication that is very close to human communication. Bees form some lifelong memories. They know how to conserve valuable energy by hanging almost motionless together in a swarm. They remember, organise their decisions, and process how many landmarks they pass during foraging flights.

Honey bees display fifty nine distinct behaviours that scientists have classified; which compares well with the widely recognised as highly intelligent dolphins, which have only about twice that many at one hundred and twenty three.

One third of a honey bee brain is called Mushroom Body Neurons. This is largely undeveloped in a house or nurse bee and until the bee starts to forage. Then this brain area develops rapidly and is used in critical memory storage. If the hive has a shortage of foragers, some of the nurse bees will switch jobs and become foragers. This job transition, whether triggered by age or social cues, involves changes in thousands of genes in the honey bee brain; some genes turn on and others turn off. It actually allows bees to learn and utilise additional brain power to perform very complex foraging tasks for nectar, pollen, water and propolis.

Bees must make flying decisions, weather condition decisions, visual, scent tracking and tactile decisions. They share perfect directions with their fellow workers, give and follow complex directions the first time, deal with bee enemies and unexpected, unfamiliar situations. Last of all; decide when to sacrifice their life for their colony!

If foraging bees perceive a danger at the location they are foraging, and upon returning to the hive find another bee communicating that location in a ‘waggle dance’, the bee that knows that there is danger will give a ‘stop signal’ by buzzing at 380 vibrations/second and butting with its head the waggle dancing bee who will immediately understand and stop dancing. No more bees will go to this location.

Their overall ‘intelligence’ benefits the colony. Decisions are made through learning and experience. The process where a swarm reaches consensus and selects their preferred new nesting site from the various reports of the ‘scout’ bees is a complex decision making process. Research in Australia has demonstrated that they can recognise different colours, and then use their memory of these colours to find and guide their way through a maze. Scientists are still discovering how honey bee brains works - the closer they look, the more amazed they become.