How stingless bees are able to make tall spiral nests

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Combs of two species of the stingless bee Tetragonula showing structures of (a) target patterns (Tetragonula carbonaria), (b) spirals (Tetragonula carbonaria), (c) double spirals (Tetragonula carbonaria) and (d) more disordered terraces

(Tetragonula hockingsi). Images courtesy of (a) Elke Haege; (b–d) Tim Heard. Credit: *Journal of The Royal Society Interface* (2020). DOI: 10.1098/rsif.2020.0187

A team of researchers from the University of Cambridge, Universidad de Granada and University of Veterinary Medicine Vienna, has discovered how certain types of stingless bees are able to build their nests in tall spiral shapes. In their paper published in *Journal of the Royal Society Interface*, the group describes applying lessons learned from the study of crystals to better understand how bees can create exotic structures.

Back in 2018, a picture of a spiral beehive (brood comb) created by a type of stingless bee native to Australia called Tetragonula carbonaria, went viral on the internet. People were impressed by the ability of the bees to create structures that were not just architecturally impressive, but were mesmerizing in their beauty. At the time, scientists had no explanation for how such a simple creature could create such magnificent structures out of nothing but wax. A closer look showed that the bees created their cells in hexagonal shapes then added regurgitated food, and then the queen deposited a single egg in the cell. The researchers with this new effort were at the time studying similar patterns in crystals and in mother-of-pearl created by mollusks. After finding that such patterns could be created by applying a very simple algorithm, the researchers turned their attention to the bees in Australia.

To find out if the bees were using a similar algorithm, the researchers modeled their attributes and behaviors on a computer to create a simulation of their nest-building behavior. In so doing, they discovered that the bees could very easily create spiral structures by following two very simple rules. When it was time to build a new cell, they could add a

cell to the growth front, which was the edge of the comb under construction—but it had to be placed slightly higher than its neighbors—or they could build a new cell on top of another cell, provided it was level in comparison with the other cells in the nest. The researchers note that bees following such an algorithm can build nests as high as suits them, which explains why they are able to build nests with as many as 20 layers.

(a) The open structure is like a multi-storey car park or, in this case of a spiral ramp, like the Guggenheim museum in New York (T. carbonaria). (b) Worker bees are observed to spend time clustered at the growing edges of terraces (T. carbonaria). Images courtesy of Tim Heard. Credit: *Journal of The Royal Society Interface* (2020). DOI: 10.1098/rsif.2020.0187

More information: Silvana S. S. Cardoso et al. The bee Tetragonula builds its comb like a crystal, *Journal of The Royal Society Interface* (2020). DOI: 10.1098/rsif.2020.0187