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OBSERVATORY

Unfolding the Colorful Architecture of Butterflies

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Scientists have known since the 1970s that complex structures make up butterfly scales and produce their vivid colors. Now a new study sheds light on just how those structures are formed in certain types of butterflies.

During development, the cell membranes of butterfly scales go through a folding process to create a double gyroid, a structure that looks a bit like two overlapping three-bladed boomerangs.

Each scale cell then transforms into a single gyroid by depositing chitin, a starchy material that makes up the exterior of insects, into one of the two gyroid spaces sculpted by the membranes. Then, the rest of the cell dies, leaving one intact gyroid network.

A single butterfly scale contains dozens of such gyroids of different sizes that bend and refract light to produce the exact colors on a butterfly, the study reports.

The structures were found in two butterfly families that the scientists studied, called the papilionid and the lycaenid. They used specimen samples from India, Brazil and North America.

“What’s remarkable is that multiple independent lineages of butterflies have evolutionarily stumbled on this,” said Richard Prum, an evolutionary ornithologist at Yale University and one of the study’s authors.

The discovery could provide insight to engineers trying to develop more efficient and better quality optical devices, he said.

The study appears in the June 14 issue of the Proceedings of the National Academy of Sciences.