LIFE & EVOLUTION

Earwigs bend the rules of folding

Springy joints let the insects quickly pack, unfurl their wings

BY LAUREL HAMERS

To quickly unfurl and refold their wings, earwigs stretch the rules of origami.

Yes, those garden pests that scurry out from under overturned flowerpots can also fly. Because earwigs spend most of their time underground and only occasionally take to the air, they use an origami-like series of folds to pack their wings into a surface area less than a tenth as big as when unfurled. Springy wing joints let the insects bypass some of the mathematical constraints that normally limit the way a rigid two-dimensional material can be folded, researchers report in the March 23 *Science*.

Origami theory assumes that a 2-D material being folded is perfectly rigid. But earwig wing joints, where creases form, are rich in a rubbery polymer called resilin. This little bit of stretch lets earwig wings do what a regular origami structure can't: lock into two different conformations — open or folded up — and transition between the two.

Earwigs don't normally reveal their wings, but the folded-up appendages unfurl on demand and lock into place until refolded.

JAKOB FABER/ETH ZURICH

It's an example of a bistable structure, like the slap bracelets of the 1980s and '90s that switched from a flat conformation to a curved one when whacked against a wrist, says study coauthor André Studart, a materials scientist at ETH Zurich. When locked open, earwig wings store energy in the springy resilin joints. When that strain is released, the wings rapidly crumple back to a folded position.

Such constructions can inform robotics design. Inspired by the wings, the researchers created a prototype gripper. Its rigid pieces are held together by rubbery, strategically placed joints. The structure can quickly snap from its mostly flat conformation to one that can grip a small object and hold it without constant external force.

While other materials scientists have pushed the limits of origami by making flat pieces bendable, this design stretches the hinges, says physicist Jesse Silverberg of Harvard University. Such a design has never before been implemented in this way. ■

See an earwig-inspired gripper in action at **bit.ly/SN_earwigs**