



BIO-  
MIMICRY

#### **Pax Volute Pump**

Centrifugal pumps consume massive amounts of energy and generate cavitation (tiny bubbles) as they work, causing vibration that makes them noisy and inefficient. The nature-spiraled volute pump doesn't cavitate, and thus uses 20% to 40% less juice and is two-thirds quieter. It's also gentler than its old-school counterparts: "The delta smelt [in the Sacramento River] has been munched up by pumps," says Pax Scientific CEO Jay Harman. "With the volute pump, fish go through." Pax recently got funding from VC Vinod Khosla and is bringing its ultraefficient spiral to aerospace and medicine, heat exchange and air-conditioning, wind turbines and marine propulsion.

**Calla Lily**  
Centripetal spirals—aka Fibonacci spirals—can be seen in calla lilies and nested rose petals, in nautilus shells and the faces of sunflowers, in tornadoes and water rushing down a drain. "All movement in the known universe, right down to the atomic level, is moving in this common geometry," says Pax's Harman. "It looks simple and elegant, but it's phenomenally complex."







PHOTOGRAPHS BY  
JONATHAN  
KANTOR  
BY  
KATE  
ROCKWOOD

# TRULY INTELLIGENT DESIGN

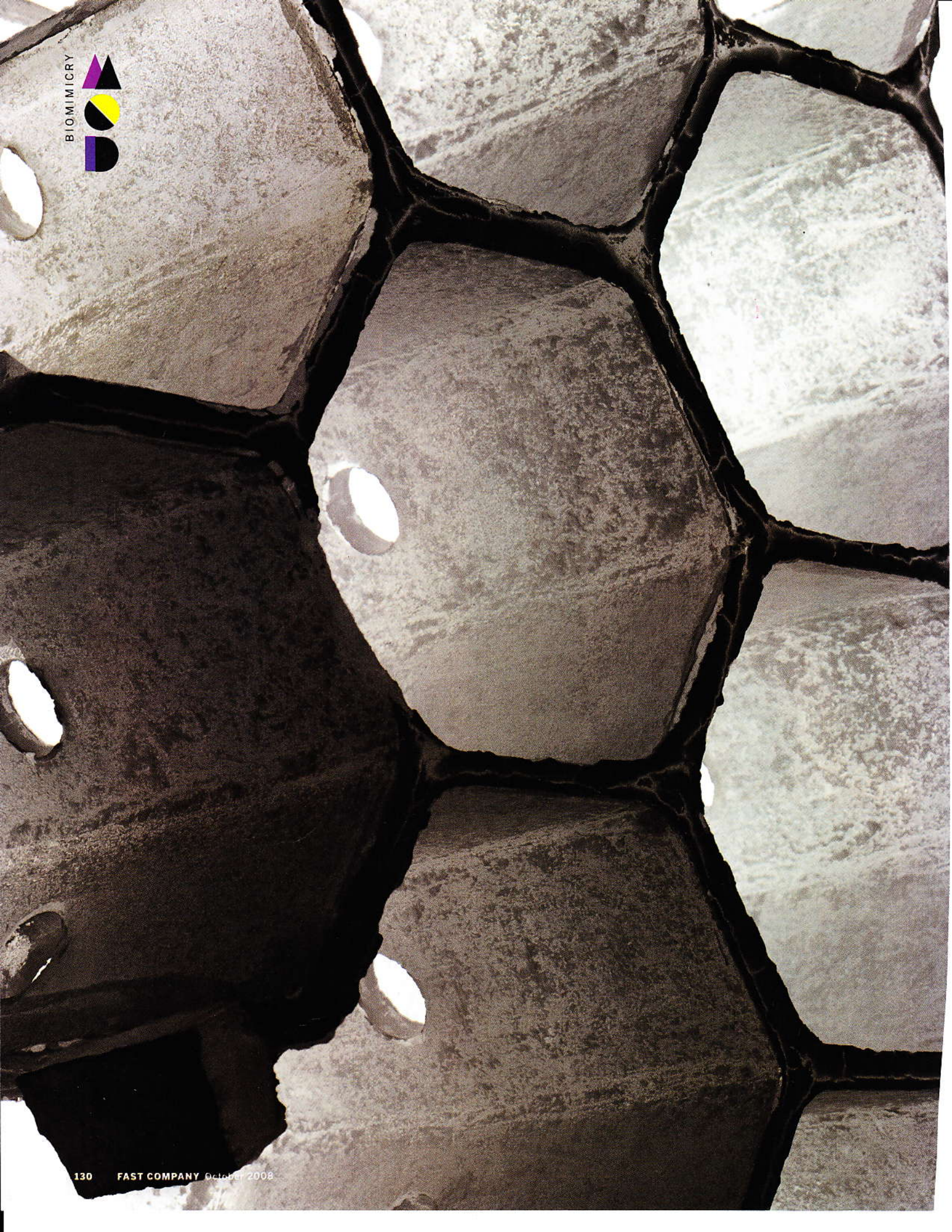
The inventor of Velcro ripped cockleburs from his dog's fur. Da Vinci and the Wright brothers studied birds in flight. And now a rising number of designers are looking to nature to nurture their creativity. "It's about taking the

genius of the natural world and learning something from it," says Janine Benyus, who coined the term biomimicry in her 1997 book, *Biomimicry: Innovation Inspired by Nature*.

Tapping into 3.8 million years of R&D and some 10 million species for insight, companies as diverse

as Boeing, Ford, General Electric, Herman Miller, HP, IBM, Kraft, Nike, and Patagonia are collaborating with the original source and welcoming biologists to the design lab. Here's a sampling of Mother Nature at work.









#### Mirror Lab

The mammoth telescope mirrors made at the Steward Observatory Mirror Lab, at the University of Arizona, would be too heavy to function if they weren't built on a hexagonal substructure inspired by honeycombs and wasp nests. Each 8.5-meter mirror weighs 52,000 pounds, 85% less than solid glass, and lightweight enough to be fitted into the world's largest telescopes. (Once completed, this mirror will be part of the Large Synoptic Survey Telescope in Northern Chile.) And since air can circulate through the permeable core, cooling the glass, the image is sharper. "The surface of the mirror doesn't vary by more than 15 nanometers," says astronomer Peter Wehinger. "To compare, think of the land between Los Angeles and New York as a flat surface that doesn't differ by more than 4 inches."



**ChromaFlair  
by JDSU**

Adored by brands such as Cadillac, Chanel, Target, and L'Oréal, ChromaFlair's refractive paints (shown here on a Trek helmet) are made of microthin film

flakes, each less than one-tenth the width of a human hair. "ChromaFlair is a replication of the effect you see on a butterfly wing," says Barbara Parker, designer for JDSU's 5,000-plus shades. "By changing the thickness of the individual flake, we can change the color you see." And because the paints are pigment free, the colors never fade.



**Morpho  
Butterfly**

A butterfly wing's colorless, translucent membrane is covered with extremely fine scales (each just 100 micrometers long). When light waves reflect off the scales and combine with other light, the result is iridescence.







#### Woodpecker

A woodpecker hammers out 25 pecks per second, hitting a tree trunk with an impact that would rip out the brains of other birds. But this master chiseler, which typically weighs a pound, uses its entire body for each blow: The tail acts as a brace and spring, and the configuration of spine and skull helps distribute the impact.

#### CAMP Woodpecker Ax

For more than 100 years, Italian sporting firm CAMP made ice axes with straight shafts. "When CAMP came to me, the first thing I did was ask, 'What is the best example of a hammer in nature?'" says designer Franco Lodato. Channeling the woodpecker, Lodato centered the shaft under the ax head and added a slight curve to the spine. Rather than setting the new pick at a near-right angle to the shaft, it was pitched downward, like the bird's beak. The result was a more balanced swing, a more efficient blow, and a best seller for CAMP.



**Morpho  
Butterfly**  
A butterfly  
wing's colorless,  
translucent  
membrane is  
covered with  
extremely fine  
scales (each just  
100 micrometers  
long). When  
light waves  
reflect off the  
scales and  
combine with  
other light,  
the result is  
iridescence.











**Motorola i560**  
A lobster's tough outer shell is made of hard and soft layers of chitin combined with calcium carbonate. After studying crustaceans,

Motorola set out to achieve similar durability by covering its i560 with hard and soft layers of polycarbonate and Santoprene, a rubberlike plastic. The i560 meets military standards for withstanding shock, dust, vibration, and temperature variation.







### Entropy Carpet by Interface

"It's only in our synthetic world that we want perfection—one shade, no blemishes," says designer David Oakey. "If we can't match a carpet's color exactly, we call it a defect. Nature doesn't work that way. Like fallen leaves, riverbed stones, or a field of wildflowers, each Entropy carpet tile is distinct and varied, yet when laid together, they blend into a cohesive pattern. Because Entropy can use multiple dye lots and be set in any direction, there's less waste during the production and installation processes."

