

# Crystal Spines

## A Fuzzy Marine Worm is on the Cutting Edge of Physics

**By Eric Powell**

In labs across the world, electrical engineers and physicists are racing to fabricate photonic band gap fibers, a novel optical material that traps light and promises to revolutionize the communications industry. [Read more in "Trapping Light" which will appear in *Discover's* April 2001 Issue.] But now Australian researchers say a lowly marine invertebrate may have beaten thousands of well-funded scientists to the punch.

The unlikely scientific prodigy is the humble spine-covered sea mouse, which looks and acts something like its mammalian namesake and lives on continental shelves at depths of 30 to 3,000 feet. Often dredged up by fishermen's nets, the worm is known for the spectacular iridescence of its spines. Curious about the sea mouse's unusual coloration, Oxford marine biologist Andrew Parker and physicist Ross McPhedran of the University of Sydney's School of Physics subjected the worm's spines to rigorous optical testing.

They found that the sea mouse doesn't rely on pigments for its exotic coloration, but achieves its brilliant iridescence through a startling feat of photonic engineering. Each sea mouse hair possesses scores of hollow, microscopic cylinders packed closely together in an arrangement almost identical to photonic gap crystal fibers, which possess total control over the movement of light photons. As in these million-dollar fibers, light striking the hair is trapped, and only certain wavelengths, such as red, are reflected, giving the hair its vivid color.

This precise control over light is the hallmark of modern photonics research. "The sea mouse is a pioneer," exults McPhedran, who says the worm's hair is so complex that reproducing nature's work wouldn't be easy. "There are only a couple of labs world wide that could make it. We're talking about big money," he says. But McPhedran and his colleagues hope further study of how the sea mouse grows its high-tech hair will help reduce the astronomical cost of making photonic crystal fiber.

Understanding the technological secrets behind sea mouse hair could

also yield other benefits. "You could make color slides that wouldn't fade over time. They would be a permanent record," says McPhedran. And the sea mouse isn't the only invertebrate which can help physicists master light. McPhedran says a burgeoning field, called optical biomimetics, scours the natural world for organic structures analogous to modern optical technologies. McPhedran already has his eye on the unique wing structures of an especially promising species of butterfly.

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**RELATED WEB SITES:**

For pictures of the sea mouse and its colorful spines, plus more information on photonic band gap research, go to Sydney University's School of Physics webpage:

<http://www.physics.usyd.edu.au/~nicolae/seamouse.html>

"Aphrodite's iridescence," by Andrew R. Parker, Ross C. McPhedran, David R. McKenzie, Lindsay C. Botten and Nicolae-Alexandru P. Nicorovici. *Nature*, 4 January 2001. See [www.nature.com](http://www.nature.com)

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