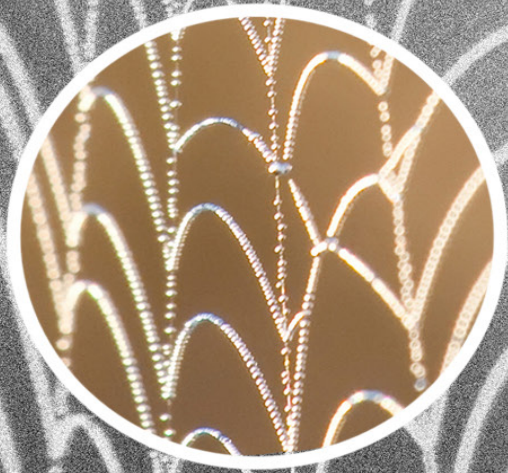


BIOMIMICRY CASE STUDY

ORNILUX® BIRD PROTECTION GLASS



ORNILUX Bird Protection Glass

Biomimicry Case Study: Biology to Design

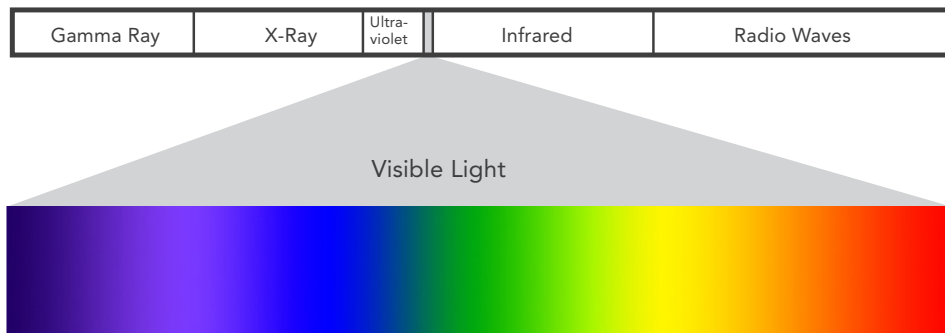
Orb weaver spiders, common worldwide, build their distinctive webs using strands of silk with UV reflective properties. Because birds can see ultraviolet light, the reflective threads prevent them from colliding with and destroying the webs. Inspired by the spider’s strategy, ORNILUX® Bird Protection Glass has a patterned, UV-reflective coating that mitigates bird collisions. If every window was an ORNILUX window, the deaths of hundreds of millions of birds could be avoided every year.

| | |
|-------------------------------------|--|
| PRODUCT | ORNILUX® Bird Protection Glass |
| INNOVATORS | Researcher Arnold Glas |
| | Company Arnold Glas |
| WEBSITE | www.ornilux.com/history-research.html |
| SUSTAINABILITY WIN | Reduces bird mortality due to window strikes |
| EMULATING FORM, PROCESS, OR SYSTEM? | Form / Process |
| LIFE’S PRINCIPLES MET | Use multi-functional design; be locally attuned and responsive |

The Inspiration



Over 3,000 species of orb weaver spiders (family *Araneidae*) are found throughout the world, including the common garden spiders of North America and Europe. These spiders construct flat webs consisting of concentric circles with spokes radiating out from the center. Females typically build the webs and use them to capture prey. While the webs are known for their remarkable mechanical properties, even the best-built webs are subject to failure if a bird strikes them. In order to protect their investment, some orb weavers decorate their webs with UV-reflective threads called stabilimenta. Though humans cannot perceive UV light, birds can, and research has shown that these UV-reflecting threads reduce the incidence of large birds and wasps crashing into the webs.^{1,2,3}



Visible light: the area of the electromagnetic spectrum visible to the human eye.

The Innovators



The imprint left after a bird collided with a glass window.
Photo by Flickr user Billtacular

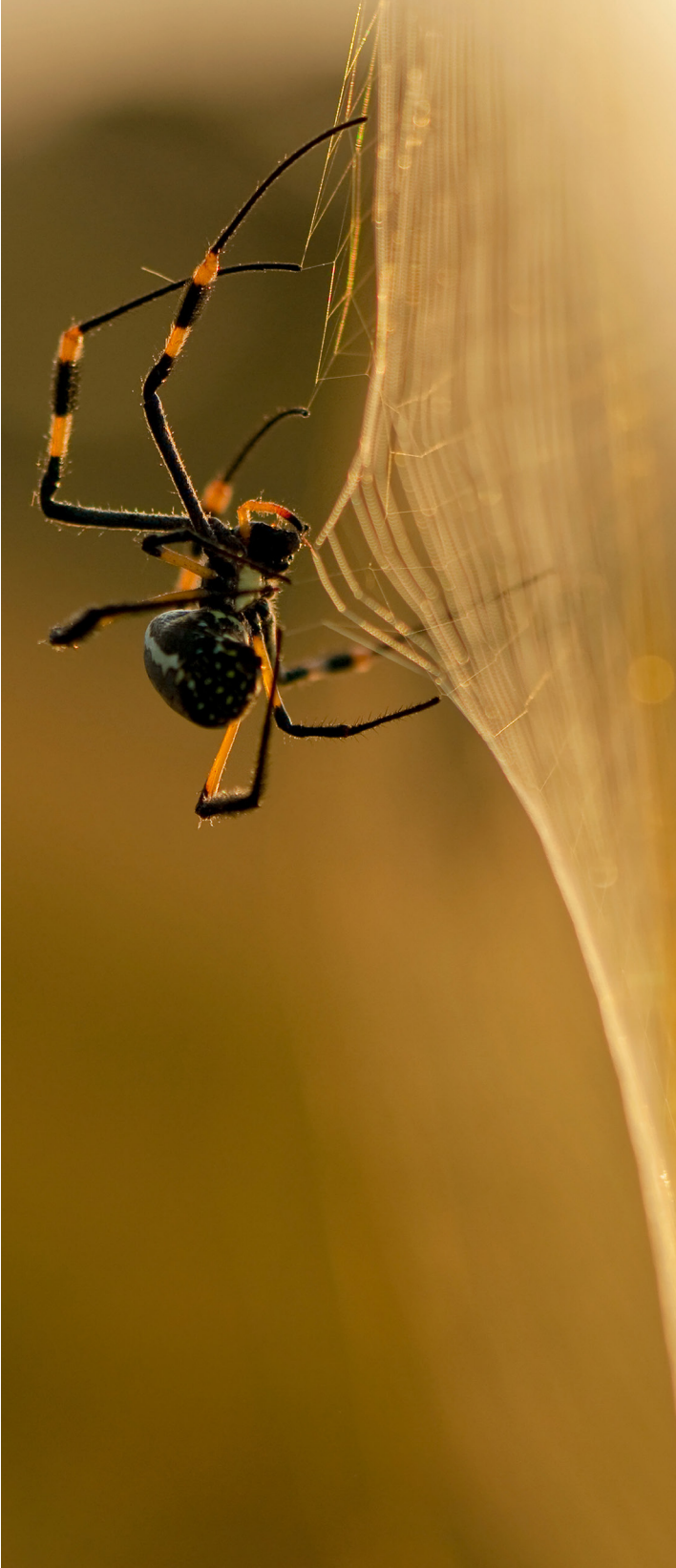
In the late 1990s Dr. Alfred Meyerhuber, a German attorney with a personal interest in birds and science, read an article in a magazine about orb weaver spiders and their use of stabilimenta. Dr. Meyerhuber was good friends with Hans-Joachim Arnold, the owner of Arnold Glas, a manufacturer of insulated glass products headquartered in Remshalden, Germany. Dr. Meyerhuber mentioned the article to Mr. Arnold and encouraged him to research how this biological phenomenon might be applied to glass to prevent birds from striking windows and killing or injuring themselves.

As a young business owner, Mr. Arnold was motivated by technical and environmental challenges and looked for ways to set Arnold Glas apart from its competition. The company motto in German is “Dinge anders tun,” which translates as “Doing things differently.” When Dr. Meyerhuber brought the orb weaver spider’s strategy to his attention, Mr. Arnold was intrigued. Despite initial resistance by the board of directors, he convinced the company to undertake the necessary research and put his company to work developing a product that would have the same UV-reflecting qualities as spider silk.

BIOLOGY TO DESIGN: MOTIVATION

Dr. Meyerhuber and Mr. Arnold knew that many birds, fooled by the reflection of trees and sky, simply do not perceive windows as a barrier. With the popularity of expansive windows and glass walls in modern high-rise architecture, bird strikes are a major cause of avian fatalities and kill an estimated 300 million to 1 billion birds globally each year.⁴ Migratory songbirds are disproportionately affected, many of which are already threatened due to hunting and shrinking habitats.^{5,6}

The Design Process



Arnold Glas's Head of Research and Development, Christian Irmischer, led the technical product development of ORNILUX. His charge was to develop a UV-reflective glass coating that would balance visibility to birds and transparency to people by capitalizing on the human eye's inability to see UV light. The coating was developed together with technicians at Arnold Glas's sister company, arcon, located in Feuchtwangen, Germany, which specializes in thin low-e and solar coatings for architectural glass. Together they innovated the process and chemistry to apply a patterned coating to glass that is only visible to birds or other organisms that can detect UV light.

The companies tested many different coating types and patterns. The researchers found that a patterned coating (versus a solid coating) made the contrast of the glazing more intense: the coated parts reflected UV light while the interlayer sandwiched between two layers of glass absorbed the UV light. The two functions together enhanced the reflective effect. Although the specific pattern of a spider's web inspired the solution, Irmischer and his team had to design a unique pattern for the window coating in order to make the application process practical.

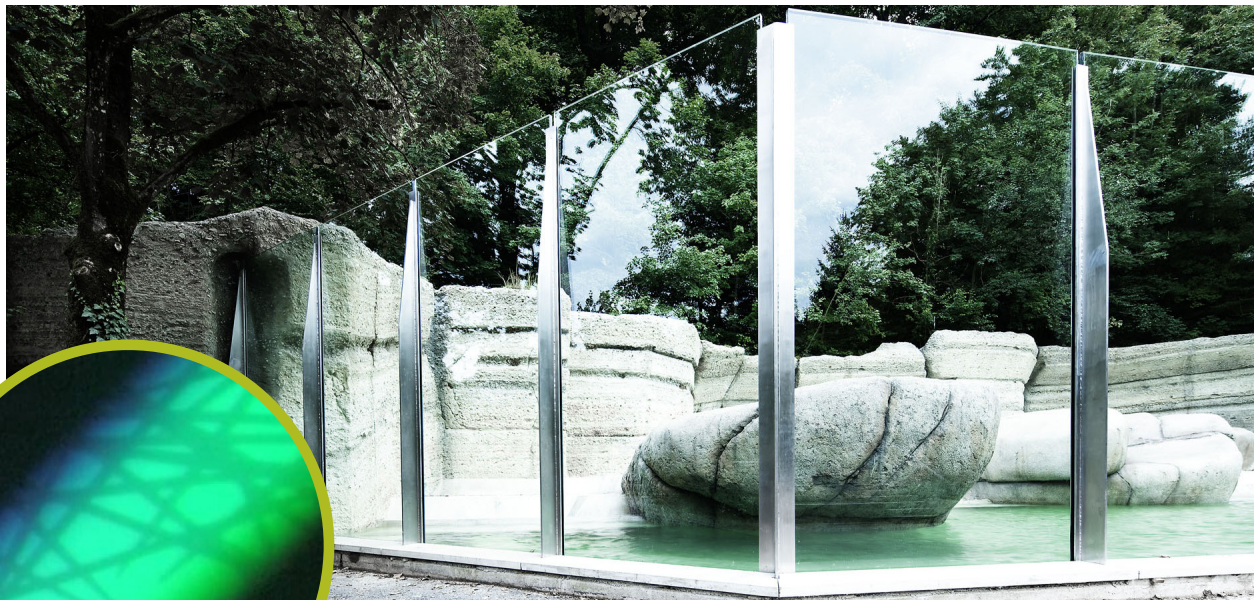
After patenting the transparent UV coating in 2001, Arnold Glas introduced ORNILUX SB1 Bird Protection Glass, its first commercial product using the technology, in 2006. The vertical lines of UV-reflective coating used in this product were sometimes perceptible but very subtle and not visually distracting. Three years later, the company introduced an improved second-generation product, ORNILUX Mikado. The name refers to the crisscrossed UV pattern of the design and comes from the German name for the game of pick-up sticks. The new pattern and improved coating of Mikado is nearly invisible to the human eye.

Why is this Product Better?

Independent pre-market testing by the Max Planck Institute for Ornithology in Radolfzell, Germany, demonstrated that ORNILUX windows are highly effective at protecting against bird strikes. To test the windows, a variety of bird species were released inside a 30' flight tunnel with two glass windowpanes at the far end – one a control pane with standard glass and the other a pane of the test glass. (In total there were 1384 test flights from 2003 to 2010.) The birds then tried to fly out through one of the perceived "openings" (a net protected them from actually striking the glass), and researchers marked each bird's chosen flight path. The UV-patterned glass significantly reduced bird strikes compared to standard double-glazing.⁷

Remarkable differences in the number of bird strikes have been noted in building projects using ORNILUX as well. The first project in the USA to use ORNILUX was at the Center for Global Conservation at the Bronx Zoo and was completed in 2009. The architects specified ORNILUX SB1 for the entire building, but in the end it was used in only a corner conference room that had the biggest risk of bird strikes. An ongoing monitoring program has noted a dramatic difference between the portions of the building with and without the bird-safe glass.

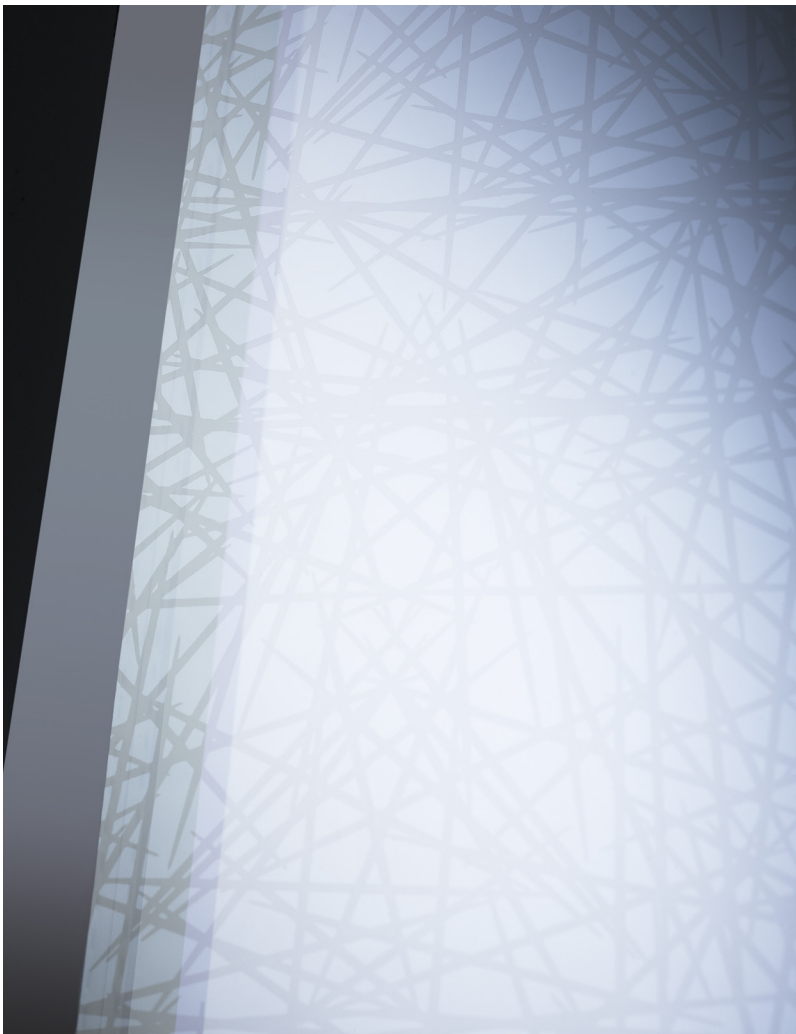
A year later, Munich's Hellebrunn Zoo used ORNILUX Mikado in the design for a new outdoor polar bear exhibit. Due to the zoo's location near the Isarauen Nature Reserve, which harbors many wild kingfishers, bird collisions were a significant concern. The zoo had other outdoor glass enclosures with a history of bird strikes, and previous attempts to use hawk silhouettes and bamboo plantings to protect the birds had failed. ORNILUX Mikado was used for the polar bear enclosure and pelican house. Zoo officials were pleased to find a solution that did not block visitors' views of the animals and noted in the first months after it was installed that no birds had collided with the glass.



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Broader Impact

As urban planners, city officials, and architects become more aware of the dangers the use of glass in buildings presents to birds, a number of cities are promoting bird-safe design and implementing bird safety building requirements. As of fall 2011, several of the U.S. Green Building Council's LEED green building rating systems offer a Bird Collision Deterrence Pilot Credit, which recommends a number of different design considerations to prevent bird strikes, including products like ORNILUX.⁸ Should these design standards become more common and if products like ORNILUX go into wider use, the deaths of hundreds of millions of birds could be avoided every year.



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PRODUCT DEVELOPMENT TIMELINE

Late 1990's

Dr. Meyerhuber shares the article about spider web stabilimenta with Hans-Joachim Arnold and R&D phase begins

2001

ORNILUX bird protection glass patented

2003-2010

R&D continues, including field and tunnel testing with the Max Planck Institute

2006

First commercial product available (ORNILUX SB1)

2007

ORNILUX installed in first building (an indoor swimming pool in Plauen, Germany)

2009

Improved product release, ORNILUX Mikado

2009

ORNILUX Mikado installed in first building (an office building in Hamburg-Wandsbek, Germany)

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Acknowledgements

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