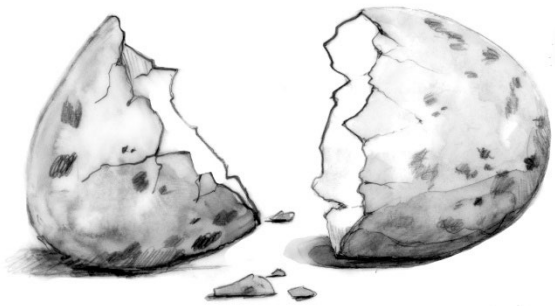
The Outside Story

The Amazing Bird Egg

By Laurie D. Morrissey



I'm often tempted to peek at the eggs inside a phoebe's nest when the parents leave it to forage for food. I've picked up a fallen robin's egg shell and admired its delicate color and smoothness. I've marveled at the primal determination of the chick that pecked its way out of an egg to become a full-fledged owl, avocet, or eagle.

Helen MacDonald, author of the books "H is for Hawk" and "Vesper Flights," put this fascination into words. At a falcon breeding research center, she held a falcon's egg close to her mouth and made soft clucking noises – and heard the unhatched chick peep back.

"I spoke through the shell to something that had not yet known light or air, but would soon take in the revealed coil and furl of a west-coast breeze … in one easy glide at 60 miles an hour, and spire up on sharp wings to soar to see the distant, glittering Atlantic. I spoke through a shell and wept."

I have not held a conversation with an egg, but I believe it to be a wondrous object – thin-shelled and light, yet surprisingly strong; porous, yet waterproof. It is one of nature's marvels, perfectly adapted to supply virtually all the needs of the avian embryo.

Evolutionary biologist Mary Caswell Stoddard investigates eggshell structure and function at Princeton University. "The most amazing thing about birds' eggs is that they are remarkably diverse – in color, patterning, size, and shape – even though they all have the same purpose, which is to protect and nourish the chick until it hatches," she said.

The avian egg comes complete with nutrients, minerals, antimicrobial proteins, and water. It needs only two things from the outside: air (it absorbs oxygen and discharges carbon dioxide through microscopic pores in the shell) and parents to keep it warm and turn it occasionally so the embryo within doesn't stick to the shell membranes.

Amazingly, the shell is strong enough to resist fracture from the outside, yet delicate enough to break from within when necessary. I remember childhood egg and spoon races. We took off with our wobbly cargo hoping to reach the finish with eggs intact. Inevitably, there were a few dropped eggs. I assumed they broke because they were weak. I was wrong.

“The eggshell is one of the fastest-forming biomaterials in nature. The calcium carbonate shell typically forms in under 24 hours,” Stoddard explained. The eggshell’s strength comes from calcium-containing minerals, including one that comprises osteopontin, a protein also occurring in bones.

Although a chicken egg is only about 1/100 of an inch thick, and brittle enough to crack when dropped, an egg standing on end is strong enough to withstand compression. If you squeeze it lengthwise it is almost impossible to break, because the arch shape at the ends distributes the force evenly. Studies have shown the chicken egg’s compressive strength to be 100 pounds, the ostrich’s more than 1,000.

The shell also has the ability to change over time. It is hardest when first laid, and its strength decreases as the chick extracts calcium for its development. It is weakest just before hatching begins.

One of the characteristics Stoddard studies is egg shape. “Owls tend to lay round eggs, while hummingbirds lay elliptical eggs, and many shorebirds lay pointy eggs,” she said. She has shown a relationship between flight ability and egg shape. “In general, better fliers tend to lay eggs that are more elliptical or asymmetric. We do not think that egg shape changes during flight, or that certain egg shapes are more aerodynamic. Instead, we hypothesized that flight behavior is related to other aspects of a bird’s body plan (like width of the pelvis), which may ultimately influence the egg-shaping process.”

Mark E. Hauber, author of “The Bird’s Egg,” also reports variation in shell thickness. “Parasitic eggs [such as those of brown-headed cowbirds] are typically thicker in the shell than similarly sized non-parasitic eggs,” he said. “They also have specialized crystalline boundaries of the shell matrix; either or both of these together make the parasite’s eggs stronger.” This strength may help when a cowbird lays her egg while perching on the edge of an unprotected nest.

Eggshells have been the subject of much research in the biological, chemical, and engineering sciences, largely due to the commercial importance of chicken eggs. I’ll leave it to researchers to crack the secrets of the avian egg, while I simply continue to admire this amazing natural wonder.

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