

FEATHERS

THOR HANSON

FEATHERS

The

EVOLUTION

of a

NATURAL

MIRACLE

BASIC
BOOKS



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The

EVOLUTION

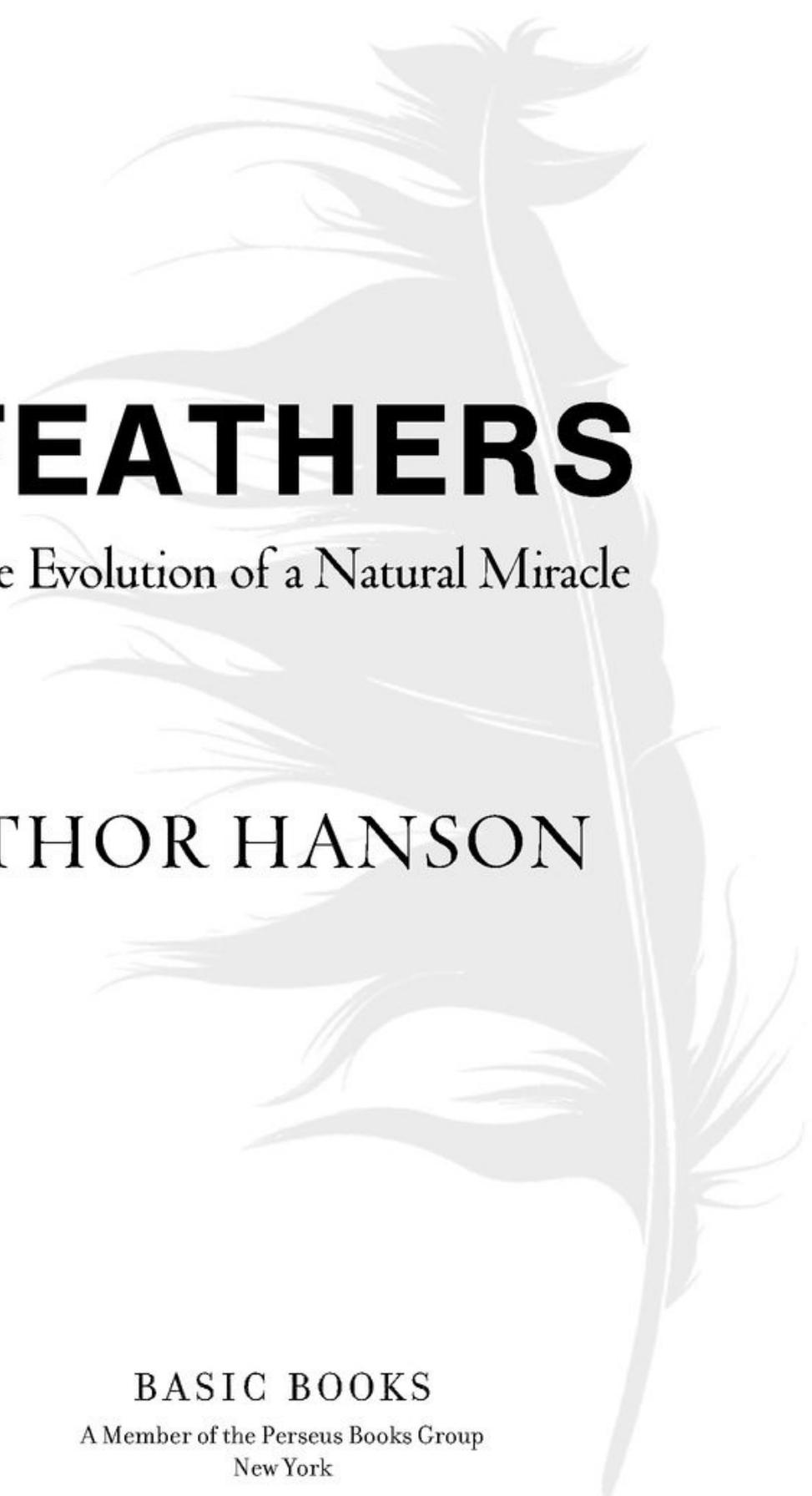
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FEATHERS

The Evolution of a Natural Miracle

THOR HANSON

BASIC BOOKS

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The Impenetrable Forest: My Gorilla Years in Uganda

Author's Note

Throughout this book, birds are referred to using English names standardized by the International Ornithological Union. By this convention, individual species are capitalized (e.g., Winter Wren, Lesser Bird of Paradise), while groups of birds or generic references are not (e.g., the wrens, the birds of paradise). The IOC species list is maintained online and updated regularly by an international panel of ornithologists (see Gill and Donsker 2010). It eliminates the need to clutter up the text with endless parenthetical Latin binomials. I've similarly avoided in-text citations in favor of trailing phrase notes which identify quotations and highlight important source material for each chapter. See the notes section, which begins on page 283. A complete list of references is included in the bibliography.

Acknowledgments

Writing a book of this kind relies on the generosity of others. From scientists and museum curators to fishing guides and fashion designers, people throughout the world of feathers have come to my aid over time and again—assisting with research, answering questions, sharing data and specimens, and sitting down for long feather-filled conversations. Here, in no particular order, are some of the people and organizations that have helped me along the way:

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Preface

O! I am Fortune's fool.

—William Shakespeare,
Romeo and Juliet (ca. 1595)

Vultures made me do it. That's my stock answer now, whenever people ask me about this book. It was vultures that first spurred my interest in feathers, years ago on a research project in Kenya. Watching the great birds hiss and squabble around a carcass, I thought of how perfectly their feathers (and lack thereof) were suited to the lifestyle. Bare heads and necks provided for cleaner feeding as well as heat regulation, stretched out long to keep cool during the day and tucked back into a plush, downy collar at night. Their dark body plumage resisted bacteria and absorbed the hot African sun, helping them stay warm in the chilly high altitudes where they soared, searching for the next kill.

The vultures started me thinking about feathers, and I've never stopped. I've seen flycatchers and nightjars burdened with breeding plumes three times their body length and watched penguins plunge beneath ice floes, comfortably watertight inside their satiny coats. I've huddled in a goose-down sleeping bag on subzero nights, while the tiny kinglets I studied kept perfectly warm nearby, fluffed up against the icy winter wind. I've traced feather shapes in the stone of dinosaur fossils and seen them in flying machines, fishing lures, Victorian hats, shuttlecocks, fletching, and ancient Peruvian artwork. As ornithologist Frank Gill observed in his classic textbook, *Ornithology*, "The details of feathers have fascinated biologists for centuries; it is an enormous topic." Perfect for a book, I'd often thought, but it would take another vulture to set me on the path.

Let me explain. As a field biologist, I'm never at a loss for things to study or topics to write about; everything in the natural world is fair game. If I'm not intrigued and excited every time I step outside, it just means I'm not paying attention. Some people find it excruciating to go for a hike with me and my constant distractions: bird nests, butterflies, lichens, ant hills, soil types, bug frass, rocks—you name it. At home, my wife, Eliza, puts up with dead voles and songbirds tucked into the freezer; plastic specimens filling the fridge; boxes of unidentified bees, old bones, and owl heads; and a big tank full of interesting grubs. (Our baby, Noah, puts up with a lot, too, but he's never known anything different!) I'm a fundamentally curious person, and it's never hard finding subjects of interest; the challenge lies in narrowing them down.

In the world of scientific research, competition for funding quickly eliminates most possibilities. Science takes money, and you need a timely, sexy topic to pick up grants. It's not surprising that whales and tigers get more attention than liverworts, click beetles, or mold. Basic field biology can be a tough sell, and I usually frame my work in the context of larger themes: habitat fragmentation, species conservation, population genetics, or even the ecological impacts of warfare. When my schedule finally opened up to start a new book, however, I found the range of potential topics almost overwhelming. On the first morning, I sipped coffee and stared at an empty page before finally starting a vulture story I'd been meaning to jot down for years (you'll find it in Chapter 15). I hoped it would at least get the creative juices flowing, and it might come in handy if I ever wrote "the feath

book.”

I'm not the world's fastest scribe, but I had a few rough paragraphs by the time I broke for a middle run. We live on an island, five miles from town on a country lane that slopes gently downhill through dense woods and out between two farm fields. As I jogged along, thinking about vultures and feathers, my nose registered the growing rot-and-copper reek of a dead animal. I entered a stand of trees, and there, sure enough, lay the upended rib cage of a road-kill deer, splayed out beside the ditch. Overhead, a young Bald Eagle kept vigil on a fir branch, and above him, higher in the same tree, sat four Turkey Vultures. They hunched together in a dark row, their red heads lowered, silent and staring.

I slowed, and the vulture on the end suddenly started up, flapping awkwardly, each wing beat a whistling strain for lift in the cool autumn air. It tilted and angled through the branches, banking sharply to gain the unobstructed sky above the roadway. As it passed overhead, I saw something drop from its left wing and drift, spinning, then wafting, then spinning again, to the ground at my feet. It was a flight feather—long, dark, and beautifully curved, lying there on the pavement like an open parenthesis.

Now, I'm a scientist and a bit of a skeptic. I don't read horoscopes, visit clairvoyants, or spend a lot of time worrying about fate. I do, however, have several friends capable of staging elaborate practical jokes. My first reaction was to look for the hidden camera, or listen for the sound of muffled laughter coming from behind a hedgerow. But of course there was nothing, just my breathing, the quiet woodsy sounds, and the retreating flight noise of the bird. It really did appear that after spending the morning writing about vultures and their feathers, I'd gone for a run and bumped into a bunch of vultures, and that one of them had practically dropped a feather on my head.

“You don't choose what to write—it chooses you.” I first heard that maxim intoned with great significance during an undergraduate creative writing seminar. At the time, it made me glad I had a double major in ecology, where I could balance such notions with a dose of comfortably prosaic tables, graphs, and data sets. Now, the phrase seemed less cliché than command. Ancient Egyptians revered vultures as far-seeing symbols of empire, truth, and justice, never to be denied. Fortunately, these birds had given me a mandate I was glad to fulfill. Decision made: I would write the feather book.

With a nod to the trio still perched in their fir tree, I picked up the feather and carried it home. It's here with me now, the vulture's benediction, token of an exploration just beginning, and a fascination that will never end.



INTRODUCTION

A Natural Miracle

Lewis stoops to pick up a red-tinged feather lying on the path. He tells me that it belongs to a flicker, points out some of its features—rachis, vanes, calamus—then, giving it to me, says that I now hold in my hand a natural miracle.

—Leonard Nathan,
Diary of a Left-Handed Birdwatcher (1999)

I walked in the lead as the group turned onto a path by the field's edge, stepping softly in the dew-wet grass. Our shadows stretched westward in the morning sunlight, crazily adorned with binocular shapes, tripods, and the long limbs of spotting scopes. It was the first spring field trip for the local Audubon club. We had started with great blue herons and a pair of yellowlegs patrolling the tide flats and were slowly making our way inland toward a freshwater marsh, where I knew the wood ducks had recently returned from migration. Scattered milk-white clouds scudded through the blue overhead, and the sun felt warm against our faces, a strange but welcome sensation after the rain-soaked Pacific Northwest winter.

My eye caught a flutter of wings and a flash of russet near the fence line. I raised my binoculars and the bird came into clear focus, standing alert in the short, green grass. "There's a—," I began, but my mind went blank. The group stopped, and I sensed everyone turning to look, lifting binoculars, and setting up scopes. It was an obvious bird, really, hardly worth mentioning to a group of pros like this. "By the fence there. It's a—." I reached for the name again, but got nothing. A mental dial tone.

"It's a *robin*," the man next to me said acidly, lowering his binoculars. The others turned away to look and there was a moment of awkward silence. I was leading an Audubon Society field trip, and I had just forgotten the name of the American Robin, possibly the most common backyard species on the continent. In the bird-watching community, this was a faux pas akin to an astronomer's forgetting the name of the Earth. Just then I heard someone say "Warbler!" and the group hurried off up the trail. With my credibility pretty much shot, it was a relief to stay behind and watch the robin.

The subtle rust and charcoal hues of her plumage told me it was a female, and her feathers shone fresh and porcelain smooth in the sunlight. She cocked her head, hopped, and then lunged forward to root at something in the soil. Tilting upright again, she suddenly launched skyward, turning sharply around a fence post and swooping up at an impossible angle to land on an alder branch. Perched there, the robin shook her tail and fluffed up her body feathers before letting everything settle back in place. Then she began to preen, turning and dipping her beak to lift and comb individual quills and vanes, like a fussy housekeeper arranging and rearranging the furniture.



American Robins, by John James Audubon.

I smiled, but who could begrudge her perfectionism? Those feathers impacted every aspect of her life. They protected her from the weather, warding off sun, wind, rain, and cold. They helped her find a mate, broadcasting her femininity to any male in the neighborhood. They kept out thorns, thwarted insects, and, above all, gave her the skies, allowing a flight so casually efficient that our greatest machines seem clumsy in comparison. Abruptly satisfied with her plumes, the robin dropped from the branch and set off over the field, wings parting the air in quick, certain strokes. I lowered my binoculars, far behind the Audubon group now, but glad to have been reminded of a natural miracle: feathers, as common around us as a robin preening and taking flight.

On any given day, up to four hundred billion individual birds may be found flying, soaring, swimming, hopping, or otherwise flitting about the earth. That's more than fifty birds for every human being, one thousand birds per dog, and at least a half-million birds for every living elephant. It's more than four times the number of McDonald's hamburgers that have ever been sold. Like the robin, each of those birds maintains an intricate coat of feathers—from roughly one thousand on a Ruby-throated Hummingbird to more than twenty-five thousand for a Tundra Swan. Lined up end on end, the feathers of the world would stretch past the moon and past the sun to some more distant celestial body. The exact number is unknowable, but one thing is certain: from the standpoint of evolution, feathers are a runaway hit.

Animals with backbones, the vertebrates, come in four basic styles: smooth (amphibians), hairy (mammals), scaly (reptiles, fish), or feathered (birds). While the first three body coverings have the

virtues, nothing competes with feathers for sheer diversity of form and function. They can be downy or soft or stiff as battens, barbed, branched, fringed, fused, flattened, or simple unadorned quills. They range from bristles smaller than a pencil point to the thirty-five-foot breeding plumes of the Ongadoro, an ornamental Japanese fowl. Feathers can conceal or attract. They can be vibrantly colored without using pigment. They can store water or repel it. They can snap, whistle, hum, vibrate, boom, and whine. They're a near-perfect airfoil and the lightest, most efficient insulation ever discovered.

Standing there, watching my robin, I was hardly the first biologist enthralled by a feather. Natural scientists from Aristotle to Ernst Mayr have marveled at the complexity of feather design and utility, analyzing everything from growth patterns to aerodynamics to the genes that code their proteins. Alfred Russel Wallace called feathers "the masterpiece of nature . . . the perfectest venture imaginable," and Charles Darwin devoted nearly four chapters to them in *Descent of Man*, his second great treatise on evolution. But the human fascination with feathers runs much deeper than science, touching art, folklore, commerce, romance, religion, and the rhythms of daily life. From tribal clans to modern technocracies, cultures across the globe have adopted feathers as symbols, tools, and ornaments in an array of uses as varied and surprising as anything in nature.

At Chauvet Cave in southern France, there is a Long-eared Owl carefully etched into the soft stone of the ceiling. Simple deft lines show the bird looking backward over its feathered shoulder in an unmistakably owlish posture. The image is one of thousands, a minor piece in the collection of petroglyphs and pictographs that make Chauvet, Lascaux, and other nearby caverns a treasure trove of prehistoric art. Haunting and evocative, their ancient animals, designs, and figures are crafted with such skill they moved Pablo Picasso to lament, "We have learned nothing in 12,000 years." In fact, the artwork at Chauvet dates back more than 30,000 years, making that small owl the world's oldest known depiction of a bird.

Although artifacts from the period include delicate bird-bone needles, flasks, beads, and pendant individual feathers are rare in these early cave paintings. Archaeologists believe that ancient hunters used feathers, too, for ornamentation and as brushes for their ochre paints. By the late Stone Age, feathered headdresses and fletched arrows appeared regularly in rock and cave art from Europe to the American Southwest to the deserts of Namibia. Already, people had co-opted feathers for uses both practical (to make an arrow fly true) and deeply cultural (as prized adornments for ceremony and status). Their varied, often vibrant colors made feathers an obvious choice for decoration. Before modern pigments, what other medium offered everything from the beige and umber of pheasants to the bright iridescence of sunbirds, motmots, and parrots? In time, feathers would spawn a global industry, clothe kings and courtesans alike, and define the height of fashion from Paris to New York. The use of feathers for fletching marked a similarly intuitive leap, from flight observed to flight intended. Indeed, their durability and aerodynamic structure would inspire engineers and inventors from da Vinci to the Wright brothers. The consistent appearance of feathers in myth and ritual, however, points to deeper mysteries.

A Long-eared Owl at Chauvet Cave, southern France.



When Emily Dickinson wrote, “Hope is the thing with feathers / that perches in the soul,” she echoed an age-old sentiment linking feathers and bird flight with a sense of portent, longing, and the human spirit. In ancient Rome, official fortune-tellers called augurs based their predictions on the behavior of birds or on patterns seen in their feathers, bones, and viscera. These bird oracles held great sway, influencing major decisions in politics as well as private life, and even today we recall the paramount importance of augury when we inaugurate presidents or speak of an auspicious occasion. Syrian Greeks, and Phoenicians divined omens from the cooing of doves, and mystics from many traditions have described the soul or the path to enlightenment in avian terms. To the Sufi poet Rumi, the human spirit was alternately a parrot, a nightingale, or a white falcon on a spiritual journey to God: “When I hear Thy drum . . . my feather and wing come back.” In central Asia, the Dolgan people described the souls of children as tiny birds perched in the Tree of Life, while shamans from South America and Mongolia have described their trancelike states as “riding the wind.” Near-death experiences invariably feature a disembodied phase, looking downward from a bird’s-eye view, and both Jung and Freud considered flying dreams among the most powerful (though whether they symbolized transcendence or rowdy sex was a point of debate).

To earthbound humanity, the ability to fly is inherently otherworldly, revered for its sheer proximity to the heavens. And if flight is sacred, then birds, wings, and feathers are its most potent symbols, appearing again and again in a dizzying range of rituals, beliefs, and customs. Birds and bird-gods figure heavily in all mythologies, and flight is the jealously guarded privilege giving the gods access to both the spiritual and the earthly planes. In ancient Greece, Hermes relied on winged sandals to speed his passage to and from Mount Olympus, but when the mortal boy Icarus flew too high, his wax and feather wings fell to pieces. The Hindu messenger god, Garuda, emerged from an egg with the body of a man and the plumage of an eagle. Flight earned him the honor of transporting Vishnu and gave him eternal advantage over his devious serpent-spirit adversaries, the Naga. Revered by Buddhists as well as Hindus, his wildly feathered visage still adorns the official seals of Thailand.

Indonesia, and Ulaanbaatar.

In some traditions, feathers are a symbol of spiritual purity and a prerequisite for an agreeable afterlife. Upon their death, ancient Egyptians believed that the jackal-headed god Anubis would measure the worth of their heart, and the soul it contained, against the weight of a feather. Those found in balance entered the pleasant kingdom of Osiris. But when the scales tipped wrong, Anubis flung the offending heart into the waiting maw of Amemait, “the Devourer,” a slaving hippo-lion-crocodile beast that crouched at his feet. In the Peruvian Amazon, the Waorani people also faced feathery judgment at death, as described by ethnologist Wade Davis in his book *One River*: “Each Waorani has a body and two souls. . . . [T]he one lodged in the brain ascends to the sky where it meets a sacred boa at the base of the clouds. If and only if its nostrils have been pierced and decorated by the finest of feathers can the soul enter heaven. If turned away, it falls back to earth and is consumed by worms.”

The connection between feathers and the sacred did not stop with shamanism or ancient mythologies but found firm footing in the great monotheistic faiths as well. Christianity, Islam, Judaism, and even Zoroastrianism all share a belief in angels, higher spiritual beings that serve as intermediaries on the path toward unity with God. Over the centuries, the depictions and descriptions of angels have been surprisingly consistent. They feature clearly recognizable human figures augmented by the addition of certain features. And what was added? Just what was given to the human form to symbolize an elevated, angelic state? More hair? Scales? A coating of sticky amphibian slime? No, ever since Vohu Manah first appeared to Zoroaster, Michael to Moses, and Gabriel to Muhammad, angels have come equipped with great feathered wings. And the feathers are diagnostic—these are not the leathery, batlike appendages featured on demons or the devil.

Like Hermes before them, angels used their gift of flight to pass from heaven to earth and back again, often bearing divine tidings. For some, their wings and feathers formed an elaborate pedigree, a sign of status. The chubby little angel haunting a Renaissance mural might boast only two short, stubby wings, while 6, 36, or even 140 pairs appear in various depictions and descriptions of the archangels. At the highest sphere, a seraphim’s feathers were said to resemble peacock plumes adorned with hundreds of all-seeing eyes. Texts like the New Testament’s Psalm 91 even attributed feathers directly to the Almighty: “He shall cover thee with his feathers, and under his wings shalt thou trust: his truth shall be thy shield and buckler.”



Mosaic of a six-winged, elaborately plumed seraphim, from the twelfth-century Chapel of the Angels at Mont Sainte Odile, Alsace, France.

Truly, the human fascination with feathers is as rich as their natural history. Any thorough exploration must span the sacred and the secular, the practical and the fantastic, from science to myth, culture, and art. Feathers give us insights into evolution and animal behavior but also provide a unique perspective on the history of human belief and ingenuity. Several main themes quickly emerge, providing a framework for the chapters of this book. *Evolution* explores the contentious mystery of feather origins—where did they come from, and why? *Fluff* investigates the amazing insulating quality of feathers, from tiny birds in an ice storm to the down in a mountaineer’s parka. *Flight* reveals how feathers opened up the skies, and *Fancy* tells the exotic story of allurements, from birds in paradise to showgirls on the Vegas Strip. A final section, *Function*, investigates how feathers continue to evolve, both in nature and in the myriad additional ways they’ve been adapted for human use. Throughout the book we meet the creatures and characters that bring the story of feathers to life, an eclectic cast of birds, dinosaurs, professors, milliners, inventors, explorers, and more.

As a writer, my job is to keep you turning the pages of this book, but as a biologist I encourage you to put it down once in a while. If you do, you’ll soon find aspects of the story very much alive in the world around you. My wife remembers her grandmother saying, “You’re never more than three feet from a spider.” Even the bestkept home hosts scores of them, tucked into dark nooks and corners or hiding behind the walls. Well, you’re never far from feathers, either. If they’re not stuffing you

pillows and parkas, they're covering every bird in every forest, field, backyard, suburb, and cityscape. You'll find feathers and their influence in fashion magazines, airplane wings, fishing lures, ballpoint pens, and fine art, but above all in the birds, those commonest of creatures so casually adorned with miracles. Go outside and watch them every chance you get. Look closely. You won't be disappointed.

Evolution

For the interesting point about a feather is really this, that it grew. It was not made in a moment, like a bullet poured red-hot into a mold: its little airy plumes, branched like a fern into tiny waving filaments, were developed by slow steps, piece after piece, and spikelet after spikelet. And what is true of this particular bit of down which I hold in my fingers, trembling like gossamer at every breath and every pulse, is also true of plumage as a whole in the history of animal evolution.

—Grant Allen, “Pleased with a Feather” (1879)

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