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'Beautiful ... Her scientific training and knowledge of plants from her Potawatomi heritage create a unique lens, teaching us how to look and watch ... Reading this has made me stop to wondrously admire any patch of moss I come across' *Quietus*

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For my family

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Preface
Seeing the World Through Moss-Colored Glasses

My first conscious memory of 'science' (or was it religion?) comes from my kindergarten class, which met in the old Grange Hall. We all ran to press our noses to the frosty windows when the first intoxicating flakes of snow began to fall. Miss Hopkins was too wise a teacher to try and hold back the excitement of five-year-olds on the occasion of the first snow, and out we went. In boots and mittens, we gathered around her in the soft swirl of white. From the deep pocket of her coat she took a magnifying glass. I'll never forget my first look at snowflakes through that lens, spangling the wooly sleeve of her navy blue coat like stars in a midnight sky. Magnified tenfold, the complexity and detail of a single snowflake took me completely by surprise. How could something as small and ordinary as snow be so perfectly beautiful? I couldn't stop looking. Even now, I remember the sense of possibility, of mystery that accompanied that first glimpse. For the first time, but not the last, I had the sense that there was more to the world than immediately met the eye. I looked out at the snow falling softly on the branches and rooftops with a new understanding, that every drift was made up of a universe of starry crystals. I was dazzled by what seemed a secret knowledge of snow. The lens and the snowflake were an awakening, the beginning of seeing. It's the time when I first had an inkling that the already gorgeous world becomes even more beautiful the closer you look.

Learning to see mosses mingles with my first memory of a snowflake. Just at the limits of ordinary perception lies another level in the hierarchy of beauty, of leaves as tiny and perfectly ordered as a snowflake, of unseen lives complex and beautiful. All

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it takes is attention and knowing how to look. I've found mosses to be a vehicle for intimacy with the landscape, like a secret knowledge of the forest. This book is an invitation into that landscape.

Three decades after my first look at mosses, I almost always have my hand lens around my neck. Its cord tangles with the leather thong of my medicine bag, in metaphor and in reality. The knowledge I have of plants has come from many sources, from the plants themselves, from my training as a scientist, and from an intuitive affinity for the traditional knowledge of my Potawatomi heritage. Long before I went to university to learn their scientific names, I regarded plants as my teachers. In college, the two perspectives on the life of plants, subject and object, spirit and matter, tangled like the two cords around my neck. The way I was taught plant science pushed my traditional knowledge of plants to the margins. Writing this book has been a process of reclaiming that understanding, of giving it its rightful place.

Our stories from the oldest days tell about the time when all beings shared a common language – thrushes, trees, mosses, and humans. But that language has been long forgotten. So we learn each other's stories by looking, by watching each other's way of living. I want to tell the mosses' story, since their voices are little heard and we have much to learn from them. They have messages of consequence that need to be heard, the perspectives of species other than our own. The scientist within me wants to know about the life of mosses and science offers one powerful way to tell their story. But it's not enough. The story is also about relationship. We've spent a long time knowing each other, mosses and I. In telling their story, I've come to see the world through moss-colored glasses.

In indigenous ways of knowing, we say that a thing cannot be understood until it is known by all four aspects of our being: mind, body, emotion, and spirit. The scientific way of knowing relies only on empirical information from the world, gathered by body and interpreted by mind. In order to tell the mosses' story I need both approaches, objective and subjective. These essays intentionally give voice to both ways of knowing, letting matter and spirit walk companionably side by side. And sometimes even dance.

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The Standing Stones

Barefoot, I've walked this path by night for nearly twenty years, most of my life it seems, the earth pressing up against the arch of my foot. More often than not, I leave my flashlight behind, to let the path carry me home through the Adirondack darkness. My feet touching the ground are like fingers on the piano, playing from memory an old sweet song, of pine needles and sand. Without thinking, I know to step down carefully over the big root, the one by the sugar maple, where the garter snakes bask every morning. I whacked my toe there once, so I remember. At the bottom of the hill, where the rain washes out the path, I detour into the ferns for a few steps, avoiding the sharp gravel. The path rises over a ridge of smooth granite, where I can feel the day's warmth still lingering in the rock. The rest is easy, sand and grass, past the place where my daughter Larkin stepped into a nest of yellow jackets when she was six, past the thicket of striped maple where we once found a whole family of baby screech owls, lined up on a branch, sound asleep. I turn off toward my cabin, just at the spot where I can hear the spring dripping, smell its dampness, and feel its moisture rising up between my toes.

I first came here as a student, to fulfill my undergraduate requirement for field biology at the Cranberry Lake Biological Station. This is where I was first introduced to mosses, following Dr Ketchledge through the woods, discovering mosses with the aid of the standard-issue hand lens, the Wards Scientific Student Model borrowed from the stock room, that I wore around my neck on a dirty string. I knew I was committed when, at the end of the class, I spent a part of my sparse college savings to send off for a professional-grade Bausch and Lomb lens like his.

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I still have that lens, and wear it on a red cord, as I take my own students along the trails at Cranberry Lake, where I returned to join the faculty and to eventually become the Bio Station Director. In all those years, the mosses haven't changed nearly as much as I have. That patch of *Pogonatum* that Ketch showed us along the Tower Trail is still there. Each summer I stop for a closer look and wonder at its longevity.

These past few summers, I've been conducting research on rocks, trying to learn what I can about how communities form, by observing the way that moss species gather together on boulders. Each boulder stands apart like a desert island in a swelling sea of forest. Its only inhabitants are mosses. We're trying to figure out why on one rock ten or more species of moss may comfortably coexist, while a nearby boulder, outwardly the same, is completely dominated by just a single moss, living alone. What are the conditions that foster diverse communities rather than isolated individuals? The question is very complex for mosses, let alone for humans. By summer's end, we should have a tidy little publication, our scholarly contribution to the truth about rocks and mosses.

Glacial boulders are scattered over the Adirondacks, the round tumbled granite left behind by the ice ten thousand years ago. Their mossy bulk makes the forests seem primeval and yet I know how much the scenery has changed around them, from the day they were stranded in a barren plain of glacial outwash, to the thick maple woods that surround them today.

Most of the boulders reach only to my shoulders, but for some we need a ladder to survey them completely. My students and I wrap measuring tape around their girth. We record light and pH, collect data on the number of crevices and the depth of the thin skin of humus. We carefully catalog the positions of all the moss species, calling out their names. *Dicranum scoparium*. *Plagiothecium denticulatum*. The student struggling to record all this begs for shorter names. But mosses don't usually have common names, for no one has bothered with them. They have only scientific names, conferred with legalistic formality according to protocol set up by Carolus Linnaeus, the great plant taxonomist. Even his own name, Carl Linne, the name his Swedish mother had given him, was Latinized in the interest of science.

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A good number of the rocks around here have names, and people use them for reference points around the lake: Chair Rock, Gull Rock, Burnt Rock, Elephant Rock, Sliding Rock. Each name calls up a story, and connects us to the past and present of this place every time we say it. My daughters, being raised in a place where they simply assume that all rocks have names, christen their own: Bread Rock, Cheese Rock, Whale Rock, Reading Rock, Diving Rock.

The names we use for rocks and other beings depends on our perspective, whether we are speaking from the inside or the outside of the circle. The name on our lips reveals the knowledge we have of each other, hence the sweet secret names we have for the ones we love. The names we give ourselves are a powerful form of self-determination, of declaring ourselves sovereign territory. Outside the circle, scientific names for mosses may suffice, but within the circle, what do they call themselves?

One of the charms of the Bio Station is that it doesn't change much from summer to summer. We can put it on each June, like a faded flannel shirt still smelling of last summer's woodsmoke. It's the bedrock of our lives, our true home, a constant amidst so many other changes. There hasn't been a summer when the parulas didn't nest in the spruces by the dining hall. In mid-July, before the blueberries ripen, a bear will regularly wander through camp, hungry. Beavers swim like clockwork past the front dock, twenty minutes after sunset, and the morning mist always hangs longest in the southern coll on Bear Mountain. Oh, sometimes things change. In a hard winter, the ice might shift the driftwood on the shore. Once a silvery old log, the one with a branch like a heron's neck, got moved sixty feet down the bay. And one summer, the sapsuckers ended up nesting in a different tree, after the top blew out of the rotten old aspen in a gale. Even the changes make familiar patterns, like the marks of waves on the sand, the way the lake can go from flat calm to three-foot rollers, the way the aspen leaves sound hours before a rain, the way the texture of the evening clouds foretells the next day's winds. I find strength and comfort in this physical intimacy with the land, a sense of knowing the names of the rocks and knowing my place in the world. On this wild shore, my internal landscape is a near-perfect reflection of the external world.

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So, I was stunned by what I saw today, on what had always been a familiar trail, a few miles down the shore from my cabin. It stopped me in my tracks. Disoriented, I caught my breath, glancing all around to reassure myself that I was still on the same trail and hadn't wandered into some twilight zone, where things are not as they seem. I've walked this path more times than I can tell, and yet it was only today that I was able to see them: five stones, each the size of a school bus, lying together in a pile, their curves fitting together like an old married couple secure in each other's arms. The glacier must have pushed them into this loving conformation and then moved on. I circle all around the pile, in silence, brushing my fingertips over its mosses.

On the eastern side, there is an opening, a cave-like darkness between the rocks. Somehow, I knew it would be there. This door which I have never seen before looks strangely familiar. My family comes from the Bear Clan of the Potawatomi. Bear is the holder of medicine knowledge for the people and has a special relationship with plants. He is the one who calls them by name, who knows their stories. We seek him for a vision, to find the task we were meant for. I think I'm following a Bear.

The landscape itself seems alert, with every detail in unnaturally sharp focus. I stand in an island of surreal quiet where time feels as weighty as the rocks. And yet, when I shake my head, clearing my vision, I can hear the familiar whoosh of waves on the shore and the redstarts chittering over my head. The cave draws me inward, on my hands and knees into the dark, beneath the tons of rock, imagining the den of a bear. I creep ahead, the rock rough against my bare arms. Around a turn the light from outside disappears behind me. I breathe in the coolness, and there is no scent of bear, just the soft ground and smell of granite. Feeling with my fingers, I go forward, but I don't quite know why. The cave floor slants downward, dry and sandy as if the rains never penetrate this far. Ahead of me, around another corner, the tunnel rises. There is green forest light ahead, so I push on. I think I must have crawled through a passage leading beneath this pile of rock and out the other side. I wriggle from the tunnel and find myself not in the woods at all. Instead, I emerge into a tiny grass-filled meadow, a circle enclosed by the walls of the stones. It is a room, a light-filled room like a round eye looking up into the blueness of the sky.

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Indian paintbrush is in bloom and hay-scented fern borders the ring of the standing stones. I am inside the circle. There are no openings save the way that I have come and I sense that entrance closing behind me. I look all around the ring but I can no longer see the opening in the rock. At first I'm afraid, but the grass smells warm in the sunshine and the walls drip with mosses. How odd to still hear the redstarts calling in the trees outside, in a parallel universe that dissipates like a mirage as the mossy walls enclose me.

Within the circle of stones, I find myself unaccountably beyond thinking, beyond feeling. The rocks are full of intention, a deep presence attracting life. This is a place of power, vibrating with energy exchanged at a very long wavelength. Held in the gaze of the rocks, my presence is acknowledged.

The rocks are beyond slow, beyond strong, and yet yielding to a soft green breath as powerful as a glacier, the mosses wearing away their surfaces, grain by grain bringing them slowly back to sand. There is an ancient conversation going on between mosses and rocks, poetry to be sure. About light and shadow and the drift of continents. This is what has been called the 'dialectic of moss on stone – an interface of immensity and minuteness, of past and present, softness and hardness, stillness and vibrancy, yin and yang.'[fn1] The material and the spiritual live together here.

Moss communities may be a mystery to scientists, but they are known to one another. Intimate partners, the mosses know the contours of the rocks. They remember the route of rainwater down a crevice, the way I remember the path to my cabin. Standing inside the circle, I know that mosses have their own names, which were theirs long before Linnaeus, the Latinized namer of plants. Time passes.

I don't know how long I was gone, minutes or hours. For that interval, I had no sensation of my own existence. There was only rock and moss. Moss and rock. Like a hand laid gently on my shoulder, I come back to myself and look around. The trance is broken. I can hear the redstarts again, calling overhead. The encircling walls are radiant with mosses of every kind, and I see them again, as if for the first time. The green and the gray, the old and the new in this place and in this time, they rest together for

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this moment between glaciers. My ancestors knew that rocks hold the Earth's stories, and for a moment I could hear them.

My thoughts feel noisy here, an annoying buzz disrupting the slow conversation among the stones. The door in the wall has reappeared and time starts to move again. An opening into this circle of stones was made, and a gift given. I can see things differently, from the inside of the circle as well as from the outside. A gift comes with responsibility. I had no will at all to name the mosses in this place, to assign their Linnaean epithets. I think the task given to me is to carry out the message that mosses have their own names. Their way of being in the world cannot be told by data alone. They remind me to remember that there are mysteries for which a measuring tape has no meaning, questions and answers that have no place in the truth about rocks and mosses.

The tunnel seems easier on the way out. This time I know where I am going. I look back over my shoulder at the stones and then set my feet to the familiar path for home. I know I'm following a Bear.

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Learning to See

After four hours at 32,000 feet, I've finally succumbed to the stupor of a transcontinental flight. Between takeoff and landing, we are each in suspended animation, a pause between chapters of our lives. When we stare out the window into the sun's glare, the landscape is only a flat projection with mountain ranges reduced to wrinkles in the continental skin. Oblivious to our passage overhead, other stories are unfolding beneath us. Blackberries ripen in the August sun; a woman packs a suitcase and hesitates at her doorway; a letter is opened and the most surprising photograph slides from between the pages. But we are moving too fast and we are too far away; all the stories escape us, except our own. When I turn away from the window, the stories recede into the two-dimensional map of green and brown below. Like a trout disappearing into the shadow of an overhanging bank, leaving you staring at the flat surface of the water and wondering if you saw it at all.

I put on my newly acquired and still frustrating reading glasses and lament my middle-aged vision. The words on the page float in and out of focus. How is it possible that I can no longer see what was once so plain? My fruitless strain to see what I know is right in front of me reminds me of my first trip into the Amazon rain forest. Our indigenous guides would patiently point out the iguana resting on a branch or the toucan looking down at us through the leaves. What was so obvious to their practiced eyes was nearly invisible to us. Without practice, we simply couldn't interpret the pattern of light and shadow as 'iguana' and so it remained right before our eyes, frustratingly unseen.

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We poor myopic humans, with neither the raptor's gift of long-distance acuity, nor the talents of a housefly for panoramic vision. However, with our big brains, we are at least aware of the limits of our vision. With a degree of humility rare in our species, we acknowledge there is much that we can't see, and so contrive remarkable ways to observe the world. Infrared satellite imagery, optical telescopes, and the Hubble Space Telescope bring vastness within our visual sphere. Electron microscopes let us wander the remote universe of our own cells. But at the middle scale, that of the unaided eye, our senses seem to be strangely dulled. With sophisticated technology, we strive to see what is beyond us, but are often blind to the myriad sparkling facets that lie so close at hand. We think we're seeing when we've only scratched the surface. Our acuity at this middle scale seems diminished, not by any failing of the eyes, but by the willingness of the mind. Has the power of our devices led us to distrust our unaided eyes? Or have we become dismissive of what takes no technology but only time and patience to perceive? Attentiveness alone can rival the most powerful magnifying lens.

I remember my first encounter with the North Pacific, at Rialto Beach on the Olympic Peninsula. As a landlocked botanist, I was anticipating my first glimpse of the ocean, craning my neck around every bend in the winding dirt road. We arrived in a dense gray fog that clung to the trees and beaded my hair with moisture. Had the skies been clear we would have seen only what we expected: rocky coast, lush forest, and the broad expanse of the sea. That day, the air was opaque and the backdrop of coastal hills was visible only when the spires of Sitka spruce briefly emerged from the clouds. We knew the ocean's presence only by the deep roar of the surf, out beyond the tidepools. Strange, that at the edge of this immensity, the world had become very small, the fog obscuring all but the middle distance. All my pent-up desire to see the panorama of the coast became focussed on the only things that I could see, the beach and the surrounding tidepools.

Wandering in the grayness, we quickly lost sight of each other, my friends disappearing like ghosts in just a few steps. Our muffled voices knit us together, calling out the discovery of a perfect pebble, or the intact shell of a razor clam. I knew from poring over field guides in anticipation of the trip that we 'should' see starfish

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the moss carpet, the fir forest and the moss forest mirroring each other. Let your focus shift to the scale of a dewdrop, the forest landscape now becomes the blurred wallpaper, only a backdrop to the distinctive moss microcosm.

Learning to see mosses is more like listening than looking. A cursory glance will not do it. Straining to hear a faraway voice or catch a nuance in the quiet subtext of a conversation requires attentiveness, a filtering of all the noise, to catch the music. Mosses are not elevator music; they are the intertwined threads of a Beethoven quartet. You can look at mosses the way you can listen deeply to water running over rocks. The soothing sound of a stream has many voices, the soothing green of mosses likewise. Freeman House writes of stream sounds; there is the rushing tumble of the stream running over itself, the splashing against rocks. Then, with care and quiet, the individual tones can be discerned in the fugue of stream sound. The slip of water over a boulder, octaves above the deep tone of shifting gravel, the gurgle of the channel sluicing between rocks, the bell-like notes of a drop falling into a pool. So it is with looking at mosses. Slowing down and coming close, we see patterns emerge and expand out of the tangled tapestry threads. The threads are simultaneously distinct from the whole, and part of the whole.

Knowing the fractal geometry of an individual snowflake makes the winter landscape even more of a marvel. Knowing the mosses enriches our knowing of the world. I sense the change as I watch my bryology students learn to see the forest in a whole new way.

I teach bryology in the summer, wandering through the woods, sharing mosses. The first few days of the class are an adventure as my students start to distinguish one moss from another, first by naked eye and then by hand lens. I feel like a midwife to an awakening, when they first discern that a mossy rock is covered not with 'moss' but with twenty different kinds of moss, each one with its own story.

On the trail and in the lab, I like to listen to my students talk. Day by day, their vocabulary stretches and they proudly refer to leafy green shoots as 'gametophytes' and the little brown thingamajigs on top of the moss are dutifully referred to as 'sporophytes.' The upright, tufted mosses become 'acrocarps,' the horizontal fronds are 'pleurocarps.' Having words for these forms

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