Beyond the Stars in front of Glacier Bay's Lamplugh Glacier.

THE GLACIERS OF ALASKA

BY MARIANNE SCOTT

GLACIERS ARE ONE OF OUR COAST'S GREAT WONDERS, AND A WORTHWHILE REWARD FOR THE LONG TRIP NORTH TO ALASKA

SINCE THE 1800S, GLACIERS have represented awesome power, romance and mystery. These icy fields, along with other natural sites untouched and uncontrolled by humans, inspired artists, composers, poets and writers. Beethoven's *Pastoral* Symphony, Caspar David Friedrich's wild landscapes and J. M. W. Turner's paintings and sketches of Swiss glaciers are but three of innumerable examples. These Romantics lionized nature in its wildest, most forceful forms and fled to it to escape the depredations of urban and industrial life.

Their views of nature are still with us. On the Pacific Coast, tens of thousands of people board gigantic ships to go north and see glaciers. Their allure lies in their immense size, their longevity, their proof of nature's might and their stunning, mesmerizing blue hues. It's the main reason we sailed our Hanse 411, *Beyond the Stars,* to Alaska in 2014.

The 19th century also produced the first studies of how glaciers affect our environment and have shaped the landscapes of virtually the whole world over time. Glaciology, as the science is known, reveals that today, glaciers cover roughly 10 percent of the earth's surface and contain three-quarters of its fresh water. Antarctica is home to the world's largest ice sheet with a thickness of up to four kilometres. Only a small percentage of the world's population live near glaciers but the runoff from these ice fields fills rivers that provide drinking water and irrigation to tens of millions. Whether glaciers advance or retreat is influenced by climate, but conversely, glaciers influence the climate by contributing to ocean volume and sea level, and by affecting the ocean's composition, temperature and circulation.

Alaska's topology reveals continuous mountainous uplift while the movement of its glaciers erodes the mountains at about the same rate. Glaciers don't stop at national borders, of course, spreading across parts of B.C. and the Northwest Territories as well. Alaska's advantage lies in that many of its glaciers reach tidewater making them accessible by boat.

1 An iceberg in Tracy Arm with its many shades of blue. 2 The debris carried by glaciers striate the rocks leaving these horizontal lines. 3 S/V *Kystcamp* cruises through bergie bits near Margerie Glacier.

ALASKA BOUND

The legendary John Muir was the first adventurer to enlighten the public about Alaska's glaciers, flora and fauna. His *Travels in Alaska* (1915) stimulated the conservationist movement (he founded the Sierra Club in 1892) and the first cruise-ship tours. We hoped to experience some of what he observed a century ago, although towns have since been built and many glaciers—but not all—are retreating. Although I know glaciers have sculpted our north Pacific environment and I've viewed nature films revealing their formation and movements, seeing real glaciers—and their effects—has changed the way I think of them forever.

My first revelation came aboard a floatplane flying over the Tongass National Forest near Ketchikan and spotting an unsubmerged, *U-shaped valley* from the air. Previously, I'd only imagined these valleys while afloat in B.C.'s innumerable fjords. We know we can scoot right up to the rock walls because glaciers have hollowed out their sides straight down. But the aerial view fixed in my mind the reality of what's beneath us when traversing a fjord.

Another flight over the Juneau Icefield and Taku Glacier (the latter, one of 38 flowing from the icefield) added to my vocabulary. Glaciers flow down mountainsides at various speeds, breaking up the ice and creating *crevasses*. When further movement and shaking makes these crevasses intersect, they build *seracs* resembling series of pointy mountain peaks.

TRACY ARM

We saw our first drifting berg at the entrance to Tracy Arm, its partially submerged bottom composed of transparent, compressed ice, and its crest snowy with gulls resting atop (bergs float because they're less dense than salt water). That bit of ice was a microcosm of how a glacier forms: it starts with billions of snowflakes, and when summers are too cool to melt what winters deposit layers accrete until their accumulated weight compresses the lower strata into ice crystals. It takes about 60 metres of snow to fuse ice crystals into *glacial ice.*

We anchored in Holkham Bay, 60 miles south of Juneau (57° 46′ 40″N 133° 37′ 0″W) after cruising through Stephens Passage. It's a spectacular location where grizzlies amble along the beach. Our guests, B.C. marine pilot Peter and his wife Joyce, made a dinghy trip to the berg to procure some blue ice for our evening's special G&T.

The next day, the bright sun allowed top-notch

The *Carnival Miracle* is dwarfed by Tracy Arm's striated mountains.

observations of a living, retreating glacier. The water was a milky turquoise colour—filled with tiny particles of ground-up rock. As Glacier Bay National Park's chief of interpretation, Tom Vanden-Berg later told me, "glaciers eat mountains for breakfast."

The numerous eccentrically shaped *growlers* were easy to avoid at the fjord's entrance, but vigilance was required to avoid bumping into larger chunks as we moved up the channel. Huge *icebergs* huddled against the fjord's walls. Some resembled snowy castles, or skyscrapers on an angle; others looked like gigantesque, gem-like ice cubes. Dark, mottled seal mothers and their pups contrasted starkly against the *ice floes* they lounged on. Flocks of pigeon guillemots zigzagged overhead. Waterfalls splashed with abandon. The glacier's grinding had left ridges in the dense granite and plants had colonized them creating ribbons of green—nature's form of terracing. With binoculars, I could even see purple lupine and red columbines having found a crack with a smidgen of soil high up the mountainside.

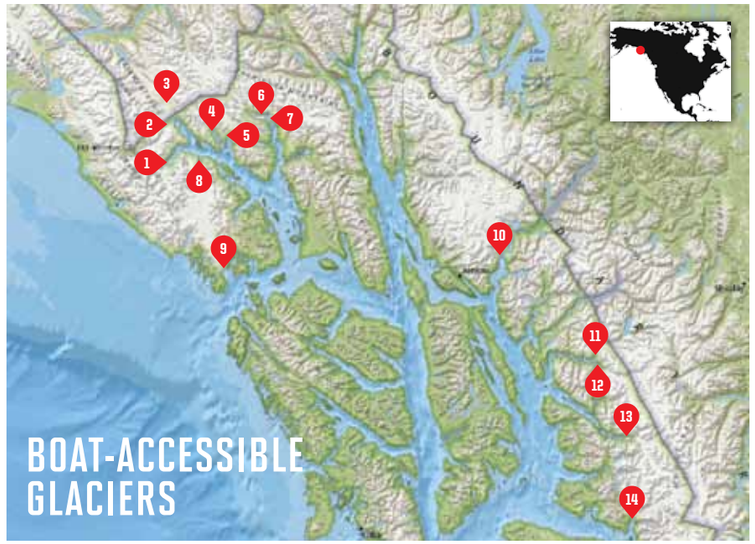
THE SOUTH SAWYER GLACIER was a majestic white, blue, and grey/black, fragmented by *fissures* and crevasses. Ice crystals absorb every colour of the spectrum except blue—an intense colour bringing to mind a sapphire. The dirt and earth the ice has scraped and accumulated during its flow down the mountains explain the glacier's grey/black streaks and stripes.

As we neared the glacier's lip, the floating ice grew thicker and we reduced speed even more. The bow pushed the ice aside and we could hear it rumbling alongside the hull. We passed an isolated rock dome standing proud—it must be super-hard granite to have withstood the relentless crushing—with a *nunatak* high above it. Suddenly a loud blast. Was the glacier calving? No, it was a rock burst just behind us. Chunks the size of small houses plunged down and left a pale trail of unweathered rock. Fortunately, we'd picked a central channel route.

The abundant floating ice prevented us from moving right up to the glacier's face, but we tarried among the floes and *bergie bits*, transfixed by the glacier's majesty and grandeur. We then turned in a great loop, never putting the engine in reverse to lower the chances for the prop to be damaged by ice. The return trip, approximately 30 miles, continued to present great vistas: more waterfalls, deeply scored mountainsides, turkey vultures soaring in the pellucid sky. Then, at the fjord's 90° turn, a sharp bow emerged and the 294-metre *Carnival Miracle* hove into sight, its passengers on the upper deck looking like a murder of crows. Amazingly, even this behemoth seemed pintsized against the mountains' slopes.

GLACIER BAY This famous locality is part of a huge national park measuring 13,000 sq-km with 50 named glaciers—15 reaching tidewater—and with glaciers accounting for 27 percent of the park's area. The glaciers wax and wane in the Fairweather Mountain Range (the southernmost portion of the Saint Elias Mountains) with elevations between 2,400 and 4,600 metres. It's a World Heritage Site and a World Biosphere Reserve.

Glacier Bay is the summer home for many whale families, other marine mammals and abundant wildlife, and that's why the park strictly regulates the number of visitors. Only two cruise



GLACIER BAY
1. Johns Hopkins Glacier
2. Margerie Glacier
3. Grand Pacific Glacier
4. Rendu Glacier
5. Carroll Glacier
6. Muir Glacier
7. Riggs Glacier
8. Lamplugh Glacier
9. Brady Glacier
10. Norris Glacier

TRACY ARM
11. Sawyer Glacier
12. South Sawyer

ENDICOTT ARM
13.Dawes Glacier

THOMAS BAY
14. Baird Glacier

GLOSSARY

Ablation The loss of ice and snow from a glacier system. This occurs through a variety of processes including melting and runoff, sublimation, evaporation, calving, and wind transportation of snow out of a glacier basin.

Calving The process by which pieces of ice break away from the terminus of a glacier that ends in a body of water or from the edge of a floating ice shelf that ends in the ocean.

Cirque A bowl-shaped, amphitheater-like depression eroded into the head or the side of a glacier valley. Typically, a cirque has a lip at its lower end. The term is derived from the Latin word circus.

Crevasse A crack or series of cracks that open in the surface of a moving glacier in response to differential stresses caused by glacier flow. They range in shape from linear to arcuate, in length from feet to miles. Their orientation may be in any direction with respect to the glacier flow. The deepest crevasses may exceed 100 feet.

Erratic A rock of unspecified shape and size, transported a significant distance from its origin by a glacier and deposited by melting of the ice. Erratics range from pebble-size to larger than a house and usually are of a different composition than the bedrock or sediment on which they are deposited.

Fissure Any long narrow cleft or crack, especially in a rock.

Glacial Ice A monomineralic type of rock, composed of crystals of the mineral ice, formed through metamorphism of snowflakes. Metamorphism results in recrystallization, increased density, and the growth of hexagonal crystals. This ice comprises the majority of the mass of a glacier.

Glacial Flour Fine-grained, silt-size sediment formed by the mechanical erosion of bedrock at the base and sides of a glacier by moving ice. When it enters a stream, it turns the stream's colour brown, gray, iridescent blue-green, or milky white. Also called glacier milk.

Moraine A general term for unstratified and unsorted deposits of sediment that form through the direct action of, or contact with, glacier ice. Many different varieties are recognized on the basis of their position with respect to a glacier.

Nunatak (Greenlandic) A mountain peak or ridge that pokes through the surface of an ice field or a glacier. It may separate adjacent valley glaciers.

Sérac A jagged pinnacle or tower of glacier ice located on the surface of a glacier, formed as a glacier flows down an icefall or by the intersection of crevasses. Frequently, large areas of a glacier will be covered by séracs.

Tarn A lake that develops in the basin of a cirque, generally after the melting of the glacier.

U-Shaped Valley A valley with a parabolic or "U" shaped cross-section, steep walls and generally a broad and flat floor. Formed by glacier erosion, a U-shaped valley results when a glacier widens and over-steepens a V-shaped stream valley.

All definitions taken from the U.S. Geological Survey's Glossary of Glacier Terminology at http://pubs.usgs.gov/of/2004/1216. Except Fissure (Wikipedia) and Glacial Flour (Wikipedia).

ships, three tour boats, six charter vessels and 25 pleasure craft can visit the park each day (still, 400,000 cruise ship trippers entered last year). We'd applied for a permit 60 days in advance, which procured us a five-day authorization. And we needed the time—two of the five days were so rainy and foggy we could barely see boats anchored nearby (it rains 228 days a year here).

REID GLACIER

The other three days were glorious. The brilliant sunshine highlighted the sheer size of the mountains, bays and glaciers. We anchored off the nearly kilometre-wide Reid Glacier that towers a good 46 metres above the waterline. Its retreat allows visitors to walk the shoreline. Our guest Janet and I had the goal of walking up to the glacier's lip and touching the ice, so we dinghied ashore. From a distance, it looked easy. In reality, we encountered surprises.

In gumboots, we began our trek up the rock-strewn coast—the *moraine*—made up of the remains left by the glacier when it begins its retreat. Rocks of every size, type and colour had been carried from great distances in the glacier's belly until *ablation* (melting) dropped them. The shore's edge was covered in grey muck, a combination of seawater and *glacial flour*, the rock the glacier has ground into dust during its inexorable course downhill. Its extreme slipperiness resembled black ice on a frosty night and we hurried to leave it in fear of becoming head-to-toe mud bunnies.

As we drew nearer the glacier, we began to hear and see rushing rivers emerging from beneath rigid blue ice—meltwater escaping through the fissures. We thought about fording the nearest stream. "Look at that current," said Janet. "Look at those rocks in the riverbed." We also saw the immense, gooey mud flats laced with boulders spread out between the rivers. Reluctantly we turned back, concluding that touching the glacier was a romantic dream.

While walking, we spotted life sprouting on the moraine. In a park seminar, we'd learned about "plant succession," first described by William Skinner Cooper in the early 1900s. It explains how plants claim territory after a glacier retreats. First mosses and lichen appear on the bare rock, then "pioneer species" like fireweed and dryas emerge. When enough soil accumulates, alder and willows root, only to be pushed out eventually by spruce and hemlock. All of this can take hundreds, even thousands, of years. To me, plant succession explains why B.C. is home to mature forests—the ice began retreating 12,000 years ago and enough time has passed to allow soil creation. In contrast, the moraine I was crossing had been de-iced only a few years ago.

LAMPLUGH AND MARGERIE GLACIERS

Lamplugh Glacier was our next stop. Painter John Ruskin wrote, "Mountains are the beginning and end of all natural scenery." And glaciers would not exist without them. As we cruised toward Lamplugh, it seemed the Fairweather Range towered ever higher. The bare slopes were covered with thick deposits of sand, silt, glacial mud and gravel. Erosion created fans of debris, with dense alder bushes growing alongside.

Lamplugh Glacier's kilometre-wide face was streaked like a gigantic sponge cake with chocolate layers. A large semi-circular cave showed off tough, blue glacial ice. The glacier is 13 kilometres long, rises 55 metres above the waterline, and plunges from three to 12 metres below. We drifted in front of this spectacular frozen mass in awe of its power and beauty.

We then turned north toward Margerie Glacier, a 34-kilometre-long stretch of ice. Its calving fills the broad fjord with tons of drift ice, with many floes carrying seals and pups. Although we didn't experience any ice avalanches, this was by far the noisiest glacier we encountered. Loud groans, booms and bangs echoed across the drifts—a glacier in action, moving, creating new crevasses and fissures, getting ready to drop chunks of ice the size of the Empire State Building.

Seeing glaciers up close and walking in areas recently vacated by glaciers calls forth both my spiritual feelings of awe and a lust to know more about the science behind these impressive acts of nature. Understanding the power and magnitude of these glaciers and how they shape the landscape is truly humbling.