

## Ice Thoughts: 2

Posted on [November 9, 2016](#)



*Study in Ice, Rock and Water.* Southern Greenland seen from 36000 feet. Photo © Susan Oliver.

*Like the white ghost of a glacier the mists advance, riding over phalanxes of tamarack, sliding across bog meadows heavy with dew. A single silence hangs from horizon to horizon.*

Aldo Leopold, “A Marshland Elegy,” from *A Sand County Almanac: With Other Essays . . .* (1949).

Travelling to Laramie for a September researching books and documents about Scottish rivers in The University of Wyoming’s [Toppan Rare Books Library](#), I was privileged to see Greenland again from the air. A similar journey in mid March led to my earlier photo-essay, [Ice Thoughts](#). The experience was again compelling, with clear skies giving breathtaking views of the Arctic ice sheet. I gazed at the spectacle. Ice, glaciers, rock and water. The polar ice caps and glaciers in particular capture our imaginations with an appeal that increases in power as its physical strength becomes more precarious. The great glaciers slide down to the Atlantic Ocean, calving icebergs into water that is a vivid azure blue only because it reflects the sky. The ocean is mysterious, not least because it returns images of something else. Its surface is like a book and the font of the Arctic is icebergs. The metaphor underpinning the glaciological term “calving” is increasingly unsettling, for what we’re seeing doesn’t suggest new life. Greenland’s glaciers are old and we know they aren’t regenerating. The process of calving has come to have little to do with new birth, and as the glaciers and sea ice thin (they used to thicken) the irony implicit in a word draws attention to a sickness: are these icebergs a monstrous progeny? Whatever, the sight speaks of grandeur and magnificence.



Glacier in southern Greenland, calving. Photo © Susan Oliver.

I was travelling on the gas-guzzling giant of an airliner that is a Boeing 747. If icebergs inscribe oceans to tell a tale of our warming planet, contrails are a script of the skies. Saying that the plane would fly regardless of whether I was on board isn't adequate. But the aim here is to take up a topic that I wrote about earlier this year, with comparisons and new thoughts about ice. As I took the photos I've used here, a friend was somewhere below on an expedition ski-ing across Greenland. I look forward to reading her account of a range of cultural as well as environmental issues – I'll post details when that work is available.

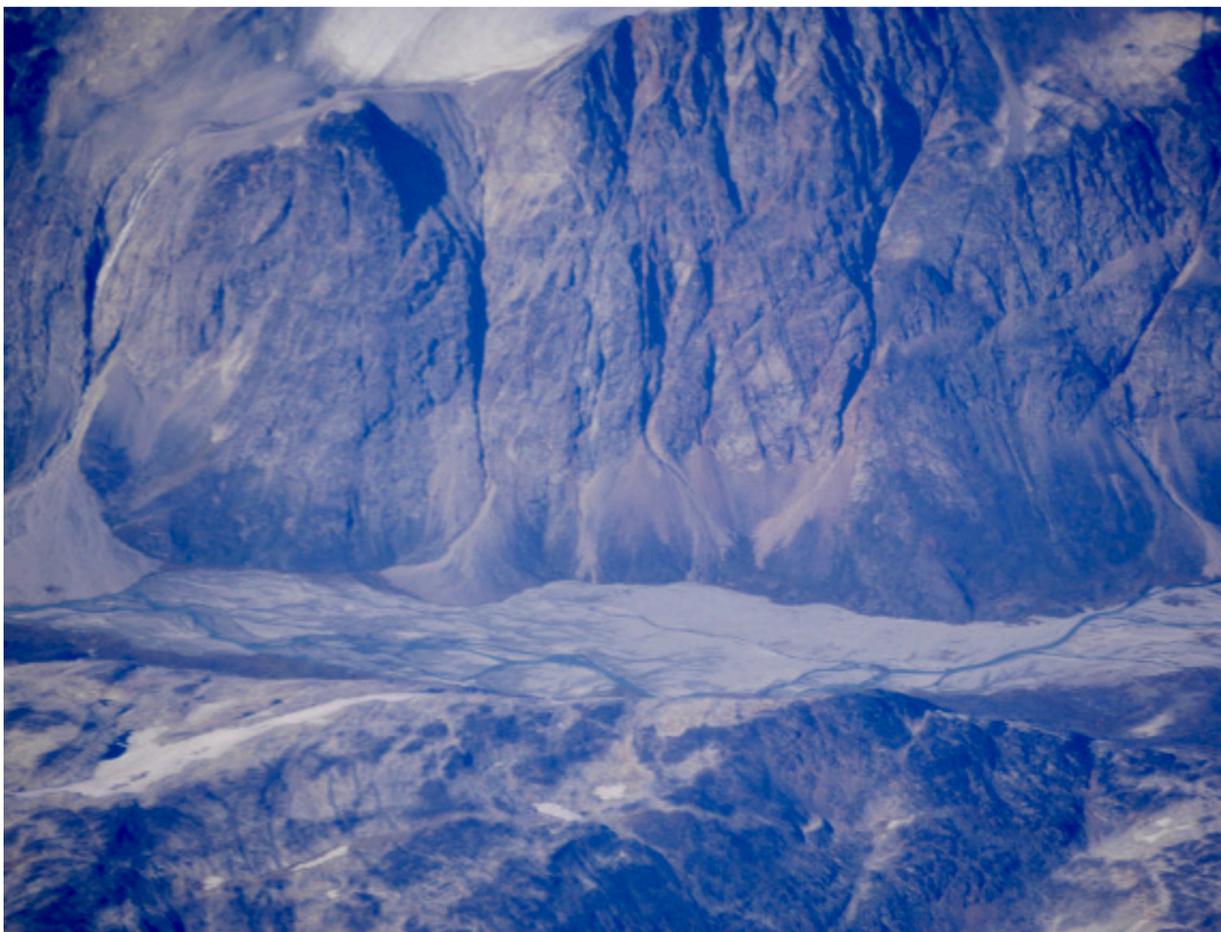
NASA's [Operation IceBridge](#) mission, which has been investigating changes in the Arctic and Antarctic ice sheets since 2009, has just made public its latest findings. *IceBridge*'s deep science study of melt and ice thickness in [Greenland's glaciers and ice sheet](#) includes a comparison of aerial photographs taken from March through to late August and early September this year. Those flights, which I didn't know of when I began working on this piece, overlapped with my own journeys, adding a scientific and artistic depth to ice writing that my two posts can't begin sufficiently to acknowledge – I've provided links that I hope readers will follow. A NASA [news post](#) from 19th August begins "This year's melt season in the Arctic Ocean and surrounding seas started with a bang, with a record low maximum extent in March." As I write, their Image of the Day (taken on 16th September) is titled "[IceBridge Observes Effects of Summer Melt on Greenland Ice Sheet](#)." Another post includes a [map](#) of ice melt under Greenland's glaciers. The mission extends matters of environmental justice beyond their implications for humans, addressing species loss in an article about the impact of diminishing ice floes on [polar bears](#): Kristin Laidre from the University of Washington's Polar Science Centre, points out that sea ice is polar bears' "platform for life," since they can't out swim the seals on which they feed. The [World Wildlife Fund](#) estimates there are currently around 22000-31000 polar bears living in 19 distinct subcultures around the Arctic cryosphere. While the population increased after hunting was controlled in the late twentieth century, predictions are for a 30% reduction in numbers by 2050 because of ice melt. Some studies estimate the [East Greenland population](#) to be around 2000 bears. [The Atlantic](#), [National Geographic](#) and the [International Business Times](#), along with some other newspapers and magazines, have just published articles about the [Antarctic mission](#) of *Project IceBridge* with some stunning photographs by Getty Images photojournalist Mario Tama who flew on the DC-8 used for the survey. Ice is news.

What place might the arts beyond visual and written works have in mediating ice science? I wonder if something like NASA's 2001 -2002 [Sun Rings](#) collaboration with the Kronos String Quartet and composer Terry Riley might be possible, further bringing together science and music? *Sun Rings*, which I remember hearing at the

[Barbican Centre in March 2003](#), worked with images and sounds from NASA space archives – similar sounds are still whistling, howling, humming and crackling though the frigid cold of space. As astrophysicist Marie Bullock wrote in her program notes, “Certain sounds from the original Voyager recordings surface throughout the performance” while “the visuals for the final movement of *Sun Rings* were inspired by The Golden Record, an information package carried into space by the Voyager spacecrafts, which includes photographs of everyday scenes from around the world—as it was in 1977.” Terry Riley and the quartet members responded musically to those sounds and images. In 1990 the Voyager 1 space probe passed icy Pluto, where the surface temperature ranges from around -240 to -218 Celsius. It is now well into interstellar space, more than 20,559,216,000 km from earth (distance at time of this post from NASA’s [Voyager Mission](#) website). We know that the earth’s atmosphere is warming and its ice melting, but how cold is space beyond the influence of the Sun?

Astrophysicists point out why it’s difficult to measure the temperature of interstellar space, but say that the average is probably around 2.725 – 3 Kelvin, or approximately -270 Celsius, while dust and gas clouds might reach 10 to 20 Kelvin, or -253 to -263 Celsius. Roughly 2.725 Kelvin is the temperature of the cosmic microwave background radiation that permeates the whole Universe. So in answer to the question of how cold interstellar space is, I quote the space and astronomy news website [Universe Today](#): “In space? It’s as cold as it can get.”

Returning to earth, how can we adequately think about ice? Are analogies helpful or obstructively anti-scientific? A friend recently pointed out that geologists warn against using anthropomorphic language to describe geophysical processes. Nevertheless, I mentioned in [Ice Thoughts](#) my University of Wyoming colleague, political scientist Teena Gabrielson’s and other scholars’ work (i.e. Jane Bennett’s *Vibrant Matter*) on the agency of the non human world, and how deeply aesthetics serve as an affective stimulus to thought. So I’ll return to some of my images of Greenland from 36,000 feet. Most people care about health. *Ice Thoughts* contemplated the beauty of the body-like patterns of Greenland’s and North Eastern Canada’s ice-scapes seen from the air in March. On this more recent journey, visible networks of alluvial fans and braided melt streams along trunk valleys, tarns and moraine, as well as the texture of the rocks themselves, suggested more anxious bodily features such as synapses, neural pathways, grey matter and nerve ends:



Alluvial fans and braided melt streams in glacial trunk valley. Photo © Susan Oliver.



Greenland: glacier and mountains. Photo © Susan Oliver.



Above: three photographs of rock and ice. The bottom image shows what is regularly referred to as the wishbone-pattern of Helheim Glacier's channels. Helheim is believed to be Greenland's fastest melting glacier. All photos © Susan Oliver.

On arrival at Denver airport a poster advertising the [Extreme Ice Survey](#) spans the end of the walkway to arrivals. The *EIS* demonstrates the effectiveness of collaborative arts, humanities and STEM research, its creative use of photography giving a “visual voice” (*EIS* website) to ecosystems affected by climate change. It's probably fair to say that most people know about the *EIS* through the documentary film [Chasing Ice](#), directed by Jeff Orlowski and featuring James Balog. Balog and the *EIS* – which he founded – are based at Boulder, Colorado, just a short drive into the Rocky Mountains from Denver. It seems appropriate that someone living in a state considerably shaped by glacial activity, but where the remaining 14 glaciers are approaching the end of their existence (see the “[Glaciers of Colorado](#)” at the *Glaciers of the American West* website of the Departments of Geology and Geography, Portland State University) would become fascinated by ice. I was teaching a seminar recently on John Muir's [Travels in Alaska](#), for my *Literature and the Environmental Imagination* module at the University of Essex, and thought of James Balog when we read Muir's account of a Presbyterian missionary in Alaska who had fallen and dislocated both shoulders. The injured man was helpless and in agony in a very dangerous environment. His concentration had been so directed towards spiritually converting native Alaskans to Christianity that he'd put himself at physical risk. Understanding the environment around him had not seemed so important. Muir, who saved the man's life, wrote:

*I marched him slowly down in the starlight on the comparatively smooth, unassured surface of the little glacier to the terminal moraine, a distance of perhaps a mile, crossed the moraine, bathed his head at one of the outlet streams, and after many rests reached a dry place and made a brush fire. I then went ahead looking for an open way through the bushes to where larger wood could be had, made a good lasting fire of resinous silver-fir roots, and a leafy bed beside it. I now told him I would run down the mountain, hasten back with help from the boat, and carry him down in comfort. But he would not hear of my leaving him.*

*“No, no,” he said, “I can walk down. Don’t leave me.”*

(John Muir, “The Stickeen River,” *Travels in Alaska*, 1915.)

The episode is from Muir’s 1879 first journey to Alaska, during which he hoped to prove his theory that the American West was shaped by glacial erosion as well as by seismic activity.

Anyone who’s watched the *EIS* film knows that while there’s no attention to shoulders, James Balog ruined his knees chasing ice. His passion, like that of Muir’s missionary, was persuading people to believe in something – in his case, that the planet’s glaciers are losing their ice much faster than previously expected and that we have to act now if we’re to stand any chance of saving them. Projects to understand what is happening not only above, but inside and under melting glaciers are now raising awareness of the complexity of different areas and types of melt and their effects. NASA’s [Global Climate Change web page](#) compares photos of Muir Glacier in Alaska – named after John Muir – in August 1941 and 63 years later in August 2004. I’m curious whether readers who clicked on the above link found themselves having to look twice at the second photo even to see the glacier, as I did. Looking down at Greenland on 31 August 2016 from 36000 feet, the amount of visible rock seemed unnerving in direct proportion to the beauty of the sight.



Greenland: glaciers and fjord. Photo © Susan Oliver.

John Muir's first published essay, for Horace Greeley's *New-York Tribune* newspaper on 5 December 1871, was titled "Yosemite Glaciers." It gave the public an explanation of the power of ice, in a vocabulary that veers between the aesthetics of the sublime, science and theology. [Two glaciers remain in Yosemite National Park](#), which Muir was instrumental in founding. The palpable sense of wonder in his essay is typical of his manner of writing:

*Glaciers work apart from men, exerting their tremendous energies in silence and darkness, outspread, spirit-like, brooding above predestined rocks unknown to light, unborn, working on unwearied through unmeasured times, unhalting as the stars, until at length, their creations complete, their mountains brought forth, homes made for the meadows and the lakes, and fields for waiting forests, earnest, calm as when they came as crystals from the sky, they depart [. . .]. The great valley itself, together with all its domes and walls, was brought forth and fashioned by a grand combination of glaciers, acting in certain directions against granite of peculiar physical structure. All of the rocks and mountains and lakes and meadows of the whole upper Merced basin received their specific forms and carvings almost entirely from this same agency of ice.*

Section subtitled "Glacier History," in "Yosemite Glaciers," *New York Tribune*, December 5, 1871.

I'm interested that Muir talks here explicitly about an "agency of ice" that operates "apart from men" to exert its force on something much older than us – the rock that it erodes – while conveying as strong a sense of its

affective agency on the human imagination. The conflict of forces that he describes, moreover, can be interpreted as evidence of an elemental ascendancy: ice triumphs over fire, for granite is an igneous rock.

As botanist as well as geologist, Muir was at least as interested in moraine as in the ice that produces it. He thrilled to comparative studies of plants that grow on the sediment left by glaciers, always looking, as Alexander von Humboldt had in South America before him, for species that evidence connection more than for those that indicate separateness. Such a comparative framework for enquiry makes Muir and Humboldt global ecologists. Each developed Johann Gottfried Herder's argument that humans exist within a "natural system" or "geographical aerology" in which all living things in a region respond to the quality and combination of the land, air, water and other local factors, which in turn contribute to a diverse universe of interrelated environments in which beauty equates with variety (Herder, *Outlines of a Philosophy of the History of Man*, 1791). John Muir's Alaska is vibrant with ice and life, and so is beautiful.

Ice also haunts. The epigraph that begins this post is from "A Marshland Elegy," an essay in which conservationist, ecologist and initiator of the term "[land ethic](#)," Aldo Leopold imagines the ghost of a glacier rolling into a localised area of Wisconsin. Leopold was writing about the marsh near to his own small farm, close to Baraboo in Sauk County, one of the Sand Counties (for more on ecology in the Sand Counties see "[Central Sand Plains Ecological Landscape](#)," Wisconsin Department of Natural resources). His shack and 264 acres of land are now a [National Historic Landmark](#). The most obvious focus of "A Marshland Elegy" is the flocks of migrating sandhill cranes that move northward in summer to nest and feed (see my previous post [Seeing beyond the Sandhill Cranes](#)). However, the spectacle of the birds becomes a means of addressing long term geological and more rapid ecological change. Their calls, which Leopold likens musically to bells, horns and trumpets – each of which can also suggest an alarm system – become the voice of a biotic community that echoes across epochs. His comparison of the migratory canes with rooted [pasque-flowers](#) (prairie smoke, cut-leaved anemone, *pulsatilla nuttalliana* or *anemone patens*) anticipates an onwardly haunted future:

*"The Cranes do not question the intent of glaciers, emperors of pioneers . . . they trumpeted a warning and sailed across the marsh to another farm."*

*"I am reminded . . . every April when the pasque-flowers bloom on every gravelly ridge. Pasques do not say much, but I infer that their preference harks back to the glacier that put the gravel there."*

Aldo Leopold, "A Marshland Elegy," from *A Sand County Almanac: With Other Essays . . .* (1949).

Leopold's deep historical account of the cranes' habitat describes how "the glacier came down out of the north, crushing hills and gouging valleys." Lobes of the same pan-North American Laurentide Ice Sheet created the basins for the Great Lakes. Glaciologists and geologists have concluded that the great glacier of the [Wisconsin Glaciation](#), the last great cycle of climate cooling and glacial expansion in North America that took place between 100,000 – 11,000 years ago, extended into Wisconsin around 31,500 years ago. Currently, paleoclimatologists are using computer modelling to increase understanding of atmospheric changes accompanying the "several massive surges of icebergs into the North Atlantic Ocean" in the [Heinrich event](#) that 11,000 years ago – the same time as the final retreat of the glacier from Wisconsin – signified "the irreversible collapse of the Laurentide Ice Sheet" ( See [Paleoclimate over the Laurentide Ice sheet at the Last Glacial Maximum](#), Polar Meteorology Goup, [Byrd Polar Centre](#) at Ohio State University and University of Maine [Climate Change Institute](#)).

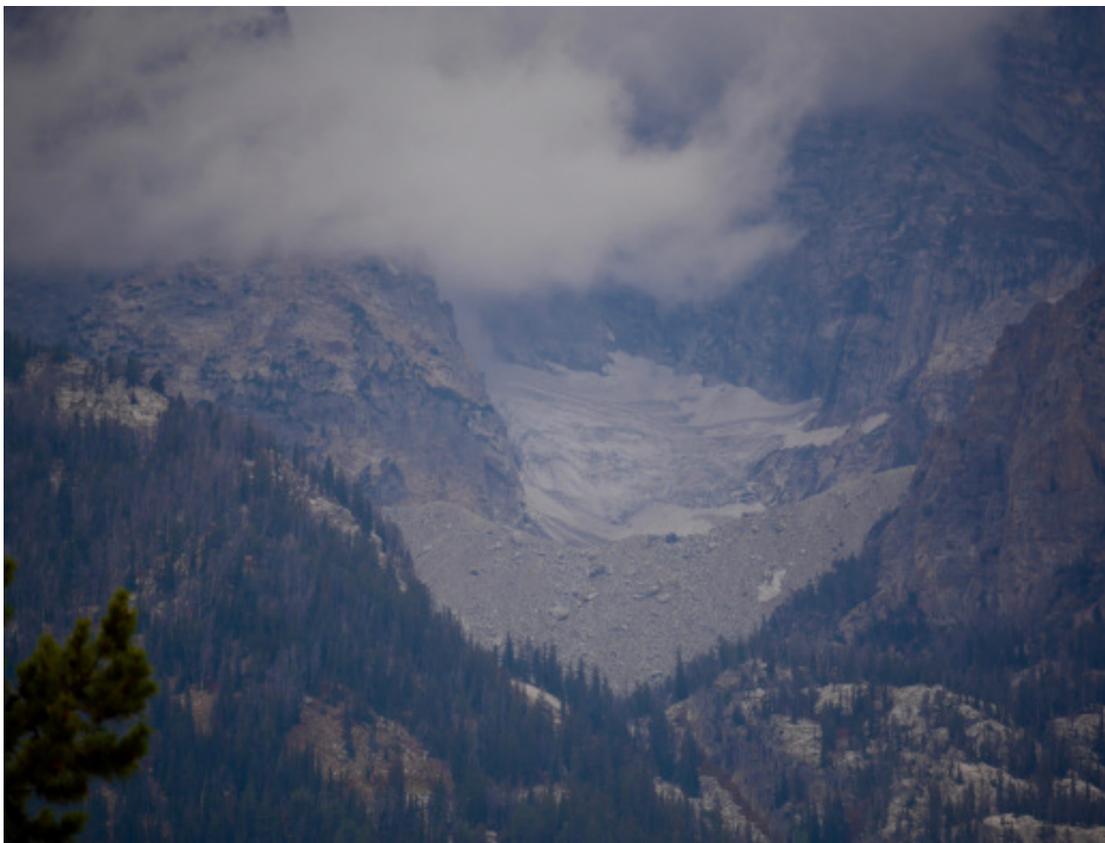
Wisconsin's post-glacial tundra gradually warmed to become swampland and a fertile, forested moraine. "A

Marshland Elegy” contrasts the Eocene origins and persistence of cranes that have lived in that environment with the fast paced violence of humans over the most recent two hundred years. English pioneers arriving in covered wagons “chopped clearing in the timbered moraines that bordered the marsh, and in them planted corn and buckwheat.” By time of Leopold’s purchase of land in 1935 and the beginning of his experiment in restoration, today’s National Park Service, while stressing the current high level of biological diversity, writes

*Wheat and corn, staple crops in Wisconsin, stripped vital nutrients from the soil, leading eventually to repeated crop failures. The combination of aggressive agricultural practices, overgrazing of livestock, and severe drought, left the landscape barren. Along with vanishing vegetation, area wildlife suffered great losses. Many indigenous animals either deserted the region to find refuge or perished owing to the depleted environment.*

[National Historic Landmark Registration Form 10-900, “Aldo Leopold Shack and Farm.”](#)

On the matter of parks, while on this research trip I took a few days to go camping and hiking in Grand Teton National Park, where a ranger, Josh, explained the basic principles underpinning the geology of the area. The Teton region is the product of glacial erosion but also of seismic activity and, as Professor Carol Frost from the University of Wyoming and her colleagues showed in a paper published earlier this year, it reveals [the collision of continental tectonic plates](#) similar in action to those that produced the Himalayas. The moraine left by glaciers from the last ice age is visible from the mountains, through its legacy of fertile sedimentary soil around the lakes and onto the plains. While it’s so obviously basic “rock science,” it still amazes me that sedimentary rocks are at the tops of the mountains. And that’s more or less where the remaining Teton glaciers continue grinding away at the rocky surface. Like other parks in the Rocky Mountain West, Teton has some thinning glaciers. I saw only one. It seemed Titanic, like a fallen giant in its mountain den:

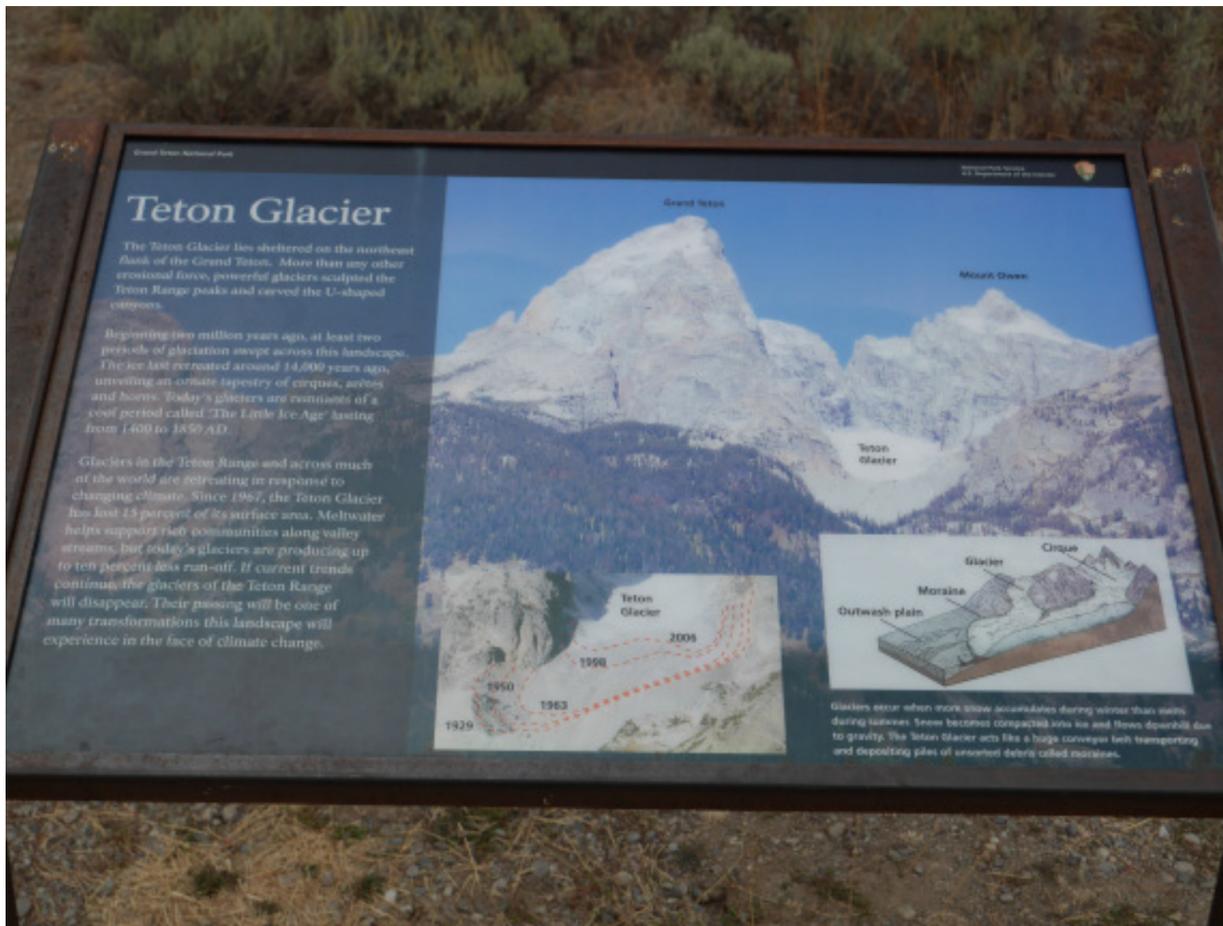


Teton Glacier and moraine. Photo © Susan Oliver.



Teton Glacier from a distance. Photo © Susan Oliver.

An information board shows the acceleration of its retreat:



Tourist Information Board showing the Glacier's retreat over almost a century. Photo © Susan Oliver.

As the tourist information board points out, Teton Glacier isn't all that old: 200 to 600 years at most. Indeed, it dates from a period when [Frost Fairs](#) were held on the River Thames in London. The Thames last froze sufficiently for a Frost Fair to take place in 1814, a year before the end of the Napoleonic Wars, at a time when Jane Austen and Walter Scott were writing novels (*Mansfield Park* and *Waverley* were published in 1814), while Lord Byron (*The Corsair*) and Wordsworth (*The Excursion*) were writing poetry, and two years before Percy Shelley wrote probably his most famous ice poem, "[Mont Blanc](#)." Shelley's poem begins with its apostrophe to "The everlasting universe of things" that "Flows through the mind," a sense of permanence that

ought now to be read as a warning about complacency in a twenty-first century of ice melt. (My friend at Leeds University and colleague in environmental humanities, [David Higgins](#), is currently writing about Shelley's "Mont Blanc," Romanticism and ruin). Mary Shelley would soon begin *Frankenstein*, which begins in an Arctic wilderness. Caspar David Friedrich's [The Sea of Ice](#), based on Edward Parry's 1819-1820 expedition to find a North-West passage through the Arctic Ocean would be painted less than a decade later in 1823.

Returning to Greenland, the surfaces of glaciers reveal their movement and their melting condition. The texture of ice represents another readable script:



Surface melt on glacier in Greenland. Photo © Susan Oliver.

A comparison of my photo above with one titled "[Ice drainage from the western Antarctic Peninsula onto the northern George VI Ice Shelf](#)," taken on 14th October by the Antarctic *IceBridge* team, demonstrates how the visible surface of ice reveals the overall polar nature of the problem of ice melt in ways that suggest both narrative and lyric. I'm trained as a specialist in Romantic literature and am thinking that these photos, with their visual language cutting across linguistic barriers, work like new lyrical ballads for a twenty-first century in which climate change is the biggest cause for global concern.

(Note: The original, experimental poems in [Lyrical Ballads](#), written and published in 1798 by William Wordsworth and Samuel Taylor Coleridge, incisively addressed threats to rural life as well as matters of universal human concern. Only two of the poems – Coleridge's "Rime of the Ancient Mariner" and Wordsworth's "Complaint of a Forsaken Indian Woman" – refer to polar ice, but the force of the collection's stories in combination with deeply philosophical thought about ethical behaviour and the land resonates into our own age of livelihoods endangered by global climate change.)

Henry David Thoreau, American transcendentalist and environmentalist, also thought about ice. [Walden](#) (1854), Thoreau's narrative of his experiment in living well, tells how a study of Walden pond in winter raises matters of philosophical, aesthetic and material concern. His disturbing account of harvesting Walden pond's ice reads as much like the butchering of an animal as it does the reaping of a crop, with blocks being "raised by grappling irons and block and tackle, and worked by horses, on to a stack [ . . . ] in a good day they could get out a thousand tons, which was the yield of about one acre" (*Walden*, Chapter 16 : "The Pond in Winter"). While Thoreau points out that less than 25% of the ice would reach its final destination, he also knew that [Boston's Ice King, Frederic Tudor](#) (1783-1864) made a fortune selling ice from Walden and other

ponds locally, to the Caribbean and to Europe. Ice was big business.

Looking back on my last photograph above, the texture of ice interested Thoreau when he used comparative language to convey a sense of aesthetic beauty and spiritual transcendence in an organic natural world beyond the human: “Ice has its grain as well as wood, and when a cake begins to rot or ‘comb,’ [it assumes] the appearance of honeycomb. Thoreau goes on to point out that the frozen structure of ice appears to have developed in sympathetic dialogue with herbaceous plants, for “Even ice begins with delicate crystal leaves, as if it had flowed into moulds which the fronds of waterplants have impressed on the watery mirror” (*Walden*, Chapter 17, “Spring”).

Returning to melt and climate change, even Thoreau’s chapter title “House-Warming” has become prophetic in ways that Thoreau probably couldn’t have anticipated. Here is his account of the effects of thawing on the pond’s ice. The simile of silver coins draws attention to the commodified status of ice, while the references to the incendiary properties of magnifying glasses and to sounds resembling guns amplify a sense of violence:

*As the last two days had been very warm, like an Indian summer, the ice was not now transparent, showing the dark green color of the water, and the bottom, but opaque and whitish or gray, and though twice as thick was hardly stronger than before, for the air bubbles had greatly expanded under this heat and run together, and lost their regularity; they were no longer one directly over another, but often like silvery coins poured from a bag, one overlapping another, or in thin flakes, as if occupying slight cleavages. The beauty of the ice was gone, and it was too late to study the bottom. Being curious to know what position my great bubbles occupied with regard to the new ice, I broke out a cake containing a middling sized one, and turned it bottom upward. The new ice had formed around and under the bubble, so that it was included between the two ices. It was wholly in the lower ice, but close against the upper, and was flattish, or perhaps slightly lenticular, with a rounded edge, a quarter of an inch deep by four inches in diameter; and I was surprised to find that directly under the bubble the ice was melted with great regularity in the form of a saucer reversed, to the height of five eighths of an inch in the middle, leaving a thin partition there between the water and the bubble, hardly an eighth of an inch thick; and in many places the small bubbles in this partition had burst out downward, and probably there was no ice at all under the largest bubbles, which were a foot in diameter. I inferred that the infinite number of minute bubbles which I had first seen against the under surface of the ice were now frozen in likewise, and that each, in its degree, had operated like a burning-glass on the ice beneath to melt and rot it. These are the little air-guns which contribute to make the ice crack and whoop.*

From *Walden*, [Chapter 13, “House-Warming.”](#) Taken here from [The Thoreau Reader](#), a project in cooperation with [The Thoreau Society](#).

On the matter of thinning ice, he describes an experiment at Harvard that again draws attention to the effect of thawing in magnifying solar rays:

*I have been told that in the experiment at Cambridge to freeze water in a shallow wooden pond, though the cold air circulated underneath, and so had access to both sides, the reflection of the sun from the bottom more than counterbalanced this advantage. When a warm rain in the middle of the winter melts off the snow-ice from Walden, and leaves a hard dark or transparent ice on the middle, there will be a strip of rotten though thicker white ice, a rod or more wide, about the shores, created by this reflected heat. Also, as I have said, the bubbles themselves*

*within the ice operate as burning-glasses to melt the ice beneath.*

From *Walden*, Chapter 17, "[Spring](#)."

Meanwhile the percussive song of the ice draws attention to its vulnerability:

*The cracking and booming of the ice indicate a change of temperature. One pleasant morning after a cold night, February 24th, 1850, having gone to Flint's Pond to spend the day, I noticed with surprise, that when I struck the ice with the head of my axe, it resounded like a gong for many rods around, or as if I had struck on a tight drum-head. The pond began to boom about an hour after sunrise, when it felt the influence of the sun's rays slanted upon it from over the hills; it stretched itself and yawned like a waking man with a gradually increasing tumult, which was kept up three or four hours. [. . .] The fishermen say that the "thundering of the pond" scares the fishes and prevents their biting. The pond does not thunder every evening, and I cannot tell surely when to expect its thundering; but though I may perceive no difference in the weather, it does. Who would have suspected so large and cold and thick-skinned a thing to be so sensitive?*

From *Walden*, Chapter 17, "[Spring](#)."

Thoreau's writing needs to be understood as being of its time, and its undeniably Romantic as well as including an informed lay understanding of science. But he surely has a lot to say to us now.

Returning to the twenty-first century, I'd like approach a conclusion by means of some final considerations and some more images from my journey over Greenland. This post began with those views. I've commented on reports of the struggle for life faced by polar bears having to adapt to shorter Arctic winters and smaller ice floes. The University of Delaware and some other institutions are working with NASA's *Project IceBridge* on a study that is predicting a restriction in the habitat and a likely decline in the population of Adélie penguins, due to shifting temperatures and ice melt. That study points out that Adélie Penguins have for millions of years responded to changes in glaciation: "the geologic record tells us that as glaciers expanded and covered Adélie breeding habitats with ice, penguins in the region abandoned their colonies. When the glaciers melted during warming periods, the Adélie penguins were able to return to their rocky breeding grounds" (see "[Climate Change May Shrink Adélie Penguin Range By End of Century](#)"). The investigation views the current situation as potentially different, however: "this warming may no longer be beneficial for Adélie penguins. In a paper published June 29 in the journal *Scientific Reports*, the researchers project that approximately 30 percent of current Adélie colonies may be in decline by 2060, and approximately 60 percent of the present population might be dwindling by 2099." Polar Bears and penguins are charismatic megafauna, as well as being sentinel or indicator species. They are large, powerful or appealing enough for their vulnerability to elicit an emotive public call for action. It's probably fair to say that they're inseparable from our idea of what the Arctic and Arctic are. What of creatures that are less visible?

While at the University of Wyoming, I was privileged to see the Art Museum's astonishing retrospective "[Waste Land: A Survey of Works by Brandon Ballengée, 1996-2016](#)." The exhibition was extremely moving. Ballengée is a marine biologist and artist who works on mutation and deformity due to habitat change, with specific attention to changes brought about by pollution. Some of his works address experimentation. I'll say more about that exhibition in my next blogpost, because it wasn't really concerned with ice. But one exhibit, Ballengée's film [Requiem pour Flocons de neige Blessés](#) (*A Requiem for Injured Snowflakes*), includes a delicate icy metaphor just as it explores the transience of melting things. Made in scientific collaboration with David M. Green of McGill University and Stanley K. Sessions, and with a haunting minimalist musical score by Ariel Benjamin and

Andrew Diluvian, the film uses a series of 21 photographs of tiny, malformed toad tadpoles from southern Quebec. The toads could not develop to maturity because of deformities due to a range of possibly interrelated causes: the exhibition's caption to the film says that "each toad was born into a hostile universe of predators, parasites and environmental degradation." The exhibition notice to *Requiem pour Flocons de neige Blessés* ends with a dedication: "This finite / infinite artwork is a memorial to all these small creatures and in honor of the countless number of beings that have come into this world and passed without notice."

That the complex ecologies of Greenland's glacial environment and the surrounding Arctic Ocean consist of tiny and short-lived creatures as well as polar bears, walruses, whales and seals is obvious and well-known. But scientists still don't know exactly how food chains and species will be affected as the glaciers and sea-ice melt. The photos used here capture beauty and uncertainty. I hope they link ice and thought. They're less abstract in appearance than those in [Ice Thoughts](#), where the aim was to let the images speak more for themselves. I've tried here to follow that earlier post by developing more extensive narrative enquiries as well as lyrical meditations about ice.



Approaching south-east Greenland. Photo © Susan Oliver.



Calving glacier with moraine. Photo © Susan Oliver.



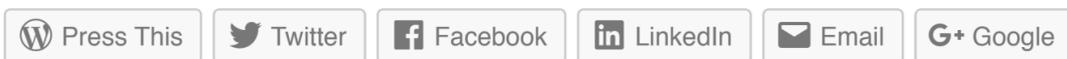
Glacial flows. Photo © Susan Oliver.



Edge of the ice-sheet, south western Greenland. Photo © Susan Oliver.

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