Six

ICE AND LIGHT

THE RADIO REPORT the evening before had been terse and ominous: gale warnings for the northern Labrador Sea. Our apprehension was over more than heavy seas, however. There were icebergs ahead—and we would be steaming into those waters in darkness, straight into a picket line of ice the size of cathedrals, borne slowly south on the Canadian Current. Implacable icebergs from the tidewater glaciers of West Greenland, the towering, gray marble walls at Savissivik and Torsukattak and Upernavik. But in those heavy seas, we knew, the ship's radar would not be able to distinguish even those fifty times larger than the ship from the wild crests of windblown waves.

The heavily laden vessel, the MV *Soodoc*,* carrying equipment and a year's supplies to an arctic mine, plowed resolutely into the dark water, taking spray over her bows. The wind vibrated cables until they moaned; it wailed through the ship's deck cranes. Waves began to wash over us amidships. The crew secured portholes and hatches on the ship's upper deck and prepared for the violent pitching and rolling to come.

We passed into Davis Strait in peace. The storm passed us to port and fell away behind, one of those strange reprieves that leave you in momentary disbelief.

In the morning I stood in the bow, watching the ship's prow split smoothly the six-foot swell of green-black water. Looming in the fog, those ice massifs that had left some of us sleepless were moving inexorably south, wreathed in gray silence, inchoate in the cold air. If we had but touched last night, the ship would have been torn by the noise of alarms and Klaxon. We would have bolted up the companionways in our storm gear for the tiny lifeboats, hobbled by half-donned clothing, brought down to the raw edge of life. Lowering away into ice and darkness in 20-foot seas, terror like a wild dog in your chest.

We passed in peace. I stared at the dark swell and thought how gently is the sparrow held that lights on a ship at sea. And then went aft, for the first meal of the day.

Montreal was far behind us. We were on the stretch, bound for the Northwest Passage; cutting the same water, seeing the same colors and animals and clear currents that Frobisher and Davis and Baffin had seen. Which is why I had asked to come. And to see the ice that had silenced them all. If I had a desire simply to be with anything in the North, it was to be with icebergs. I do not know if I had had this wish for years or if it only intensified as the prospect of the voyage loomed. But when I saw them, it was as

*For Mfotor] V[essel] Sault ("Soo") [Sainte-Marie, Ontario] d[ominion] off] c[anada], a 355-foot, 7000 dead-weight-tonnage bulk cargo ship, with a complement of twenty-three.

though I had been waiting quietly for a very long time, as if for an audience with the Dalai Lama.

On the afternoon of the day we knew the storm had passed, I stood on the starboard side of the bridge at a window, with the heavy protective glass lowered. I rested my forearms on the sill, feeling the warmth of the bridge heaters around my legs and a slipstream of cool air past my face. The first icebergs we had seen, just north of the Strait of Belle Isle, listing and guttered by the ocean, seemed immensely sad, exhausted by some unknown calamity. We sailed past them. Farther north they began to seem like stragglers fallen behind an army, drifting, self-absorbed, in the water, bleak and immense. It was as if they had been borne down from a world of myth, some Götterdämmerung of noise and catastrophe. Fallen pieces of the moon.

Farther to the north they stood on their journeys with greater strength. They were monolithic; their walls, towering and abrupt, suggested Potala Palace at Lhasa in Tibet, a mountainous architecture of ascetic contemplation. We would pass between them, separated from them by no more than half a mile. I would walk from one side of the ship to the other, wondering how something so imposing in its suggestion of life could be approached so closely, and yet still seem so remote. It was like standing in a dirigible off Annapurna and Everest in the Himalayas.

The suggestion of life around them was not an illusion. Harp seals and flocks of seabirds were drawn to fish schooling in the nutrient-rich waters at their base—an upwelling driven by freshwater runoff from the iceberg, pouring into the lighter water of the salty ocean. With my binoculars I could follow the scarves of turquoise meltwater unfurling 400 feet to the sea.

I occasionally drew back from the starboard window to make a sketch, or to bring the binoculars up to my eyes. I marveled as much at the behavior of light around the icebergs as I did at their austere, implacable progress through the water. They took their color from the sun, and from the clouds and the water. But they also took their dimensions from the light: the stronger and more direct it was, the greater the contrast upon the surface of the ice, of the ice itself with the sea. And the more finely etched were the dull surfaces of their walls. The bluer the sky, the brighter their outline against it.

I wrote words down for the tints—the grays of doves and pearls, of smoke. Isolated in my binoculars, the high rampart of a mesa-like berg seemed sheared off like a wall of damp talc. Another rounded off smoothly, like a human forehead against the sky, and was pocked and lined, the pattern of a sperm whale's lacerated tun. Floating, orographic landscapes—sections broken out of a mountain range: snow-covered ridges, cirque valleys, sharp peaks. The steep walls often fell sheer to the sea, like granite pitches, their surfaces faceted like raw jade, or coarser, like abraded obsidian.

Where the walls entered the water, the surf pounded them, creating caverns, grottoes, and ice bridges, strengthening an impression of sea cliffs. At the waterline the ice gleamed aquamarine against its own gray-white walls above. Where meltwater had filled cracks or made ponds, the pools and veins were milk-blue, or shaded to brighter marine blues, depending on the thickness of the ice. If the iceberg had recently fractured, its new face glistened greenish blue—the greens in the older, weathered faces were grayer. In twilight the ice took on the colors of the sun: rose, reddish yellows, watered purples, soft pinks. The ice both reflected the light and trapped it within its crystalline corners and edges, where it intensified.

The burden of rocks, gravel, silt, and sand that icebergs carry within them streaks their sides; as they melt, they rise higher in the water and the debris in their shoal water creates a series of waterline marks. As they fracture and tilt, the patterns of waterline marks cross at odd angles and slant skyward.

It seemed almost superfluous, but the third mate took the measure of one with his sextant: 64.7 meters high by 465.4 meters long (212.27 by 1526.88 feet). Another is 70.4 meters high by 371.0 meters long (230.97 by 1217.19 feet); but the numbers can-

not encompass them. The ice reaches far below the surface of the water and stretches away in a third dimension. It is impossible to know how much of it lies beneath the water—four-fifths of its height and seven-eighths of its mass is the mariner's general rule. And the shape of each one changes as our ship passes. New valleys, slopes of wind-packed snow, ramparts and spires, and columnar bluffs come into view. Another set of measurements of the same iceberg turns out differently.

One day, low decks of cumulus clouds bearing off to the southeast open up a horizon to the west and north. In brilliant sunshine the icebergs now gleam as crisp a blinding white in the black water as storm-lit sails. After a while icebergs near the horizon break with the surface of the ocean to float low in the pale blue sky. Four or five of them, distant mirages, not seeming to take the moment seriously at all. I return, smiling, to those immediately before me, and renew my faulty sketching. I remember the church at Ranchos de Taos, New Mexico, Saint Francis of Assisi; photographers have gone there for decades, impassioned with a desire to render it in shades of black and white only. What would an Edward Weston or a Wynn Bullock or a Paul Strand have thought of these? I stare for hours from the starboard window at these creatures I have never seen before. They drift past in the spanking, beautiful weather. How utterly still, unorthodox, and wondrous they seem.

IN the interior of Greenland the Wisconsin Ice Age continues, as it were, unabated. The Greenland ice cap, forming continuously from layers of compacted snow and trapped air and expanding at varying rates, is 1500 miles long, 450 miles wide, and up to 11,000 feet thick. It bears down with such force that the center of the island is warped some 1180 feet below sea level. The glacial tongues and margins of the ice cap reach the sea at several prominent points, where enormous sections of ice break off and float away in the currents. One of the most imposing of them is the 400-foot-

high palisade of Humboldt Glacier, which stretches north and south for 50 miles at the edge of Kane Basin.

Most of the icebergs of the Northern Hemisphere are calved from the western glaciers of the Greenland ice cap, into Disko and Melville bays. They drift north in the West Greenland Current for a while and then come south that year or the next with the Canadian Current to the Labrador Sea. As imposing as they are, icebergs are dwarfed by ice islands, a kind of ice calved along the north coast of Greenland and the northwest coast of Ellesmere Island from ice shelves that extend offshore into embayments of the ocean. (The structure and behavior of shelf ice have been likened to those of both glacial ice and sea ice, though strictly speaking it is neither.) These ice islands, up to 300 square miles in extent but only 150 to 165 feet thick, become incorporated in the polar ice pack, where they make ideal, long-term drift bases for scientific research. They are structurally sound, and their flat tops, uniformly corrugated like a tin roof, offer a working platform close to the surface of the water. (Fletcher's Ice Island [T-3], a 50-square-mile platform spawned from the Ward Hunt Ice Shelf at Disraeli Fiord, Ellesmere Island, was used by scientific parties for twenty-five years before work there was terminated in the mid-1970s.) Ice islands normally drift for decades in the ice gyre north of Alaska before being caught, finally, in the East Greenland Current, in whose waters they eventually disintegrate and melt.

Almost as extensive as ice islands but much thicker are tabular icebergs, which break off whole from the foot of a tidewater glacier. With a volume of 40 or 50 cubic miles, they are the largest objects afloat in the Northern Hemisphere. Other sorts of freshwater arctic ice include the ice that forms on arctic rivers and on tundra lakes and ponds (which may freeze to the bottom in winter), and the lenses and wedges of ground ice within permafrost. The latter influence the formation of a distinctive geometry of frost cracks in the tundra called "patterned ground," and raise the hemispherical mounds, or frost boils, called pingos. (A well-known

cluster of some 150 pingos, from 3000 to 5000 years old, rises near Toker Point, just east of the mouth of the Mackenzie River.)*

The sea ice that forms on the surface of the ocean behaves in less predictable ways than freshwater ice, depending on how it is formed and altered and on how old it is. Its physics—the distribution of forces within it, the range of its elasticity and plasticity, the structural quality of its crystal lattices—is highly complex. "Scarcely a substance on earth," writes one scientist, "is so tractable, so unexpectedly complicated, so deceptively passive."

Freshwater ice usually begins to crystallize at 39.2 °F, the temperature at which fresh water is densest. Sea ice does not achieve its maximum density, or start freezing, until it is cooled to 28.6°F. In its initial stages, the crystalline structure of sea ice incorporates brine and is not solid. It will therefore bend under a load before it fractures, while newly formed freshwater ice, brittle and also more transparent, will fracture suddenly, like a windowpane. (Because of its elasticity, even sea ice four inches thick is unsafe to walk on, while freshwater ice only half as thick will support a human being.)

In the absence of any wind or strong current, sea ice first appears on the surface as an oily film of crystals. This frazil ice thickens to a kind of gray slush called grease ice, which then thickens vertically to form an elastic layer of ice crystals an inch or so thick called nilas. Young nilas bends like watered silk over a light ocean swell and is nearly transparent (i.e., dark like the water). When it is about four inches thick, nilas begins to turn gray and is called young ice, or gray ice. When gray ice finally

* Permafrost, a unique substance, is frozen soil, not ice. Part of the confusion over how to classify it, however, arises from the fact that it behaves somewhat like ice, extending itself through the soil by a process of crystalline growth. The complex pattern of its development accounts for the facts that it underlies ground in the Arctic that was never covered by glacial ice and that east of the Taimyr Peninsula it reaches a depth of 1900 feet.

becomes opaque it is called first-year ice. And in these later stages it thickens more slowly.

By spring, first-year ice might be four to six feet thick. If it doesn't melt completely during the summer, it becomes second-year ice in the fall, tinted blue and much harder. (Brine in the upper layers has drained out during the summer and fresh ice crystals have filled the interstices.) Second-year ice continues to thicken, until it stabilizes after a few years at about 10 to 12 feet. If it remains unmelted through a second summer, it is simply called multiyear ice, or polar pack ice, to distinguish it from first- and second-year pack ice.* A more formidable version of multiyear ice, paleocrystic ice, forms in the open polar sea and may be 50 feet thick.

Pack ice may be consolidated in great expanses of rubble called field ice, or broken up by lanes of open water (leads) to a lesser or greater degree, creating various types of close and open pack ice —for example "close pack" (seven-tenths to nine-tenths coverage of the sea).t

Winds and currents almost always affect the formation of sea ice. If a swell comes up in a sludge of grease ice, for example, the crystals congeal in large, round plates that develop upturned edges from bumping against each other—a stage called pancake ice. If nilas is broken up by the wind, the separate sheets often ride up over each other in a characteristic interlocking pattern called finger-rafting. Heavier ice may ride up cleanly over itself or create low ridges of rubble or piles of crumbled fragments as it grinds

* The term "pack ice" is used in a wide sense to include any accumulation of sea ice other than fast ice (ice attached to the shore), no matter what form it takes or how disposed.

t Because sea ice presents such a grave danger to ships, precisely defined terms are critical for accurate reporting. Terms that refer to the type and extent of ice coverage are standardized in the Scott Polar Institute's *Illustrated Glossary of Snow and Ice* and the Canadian Hydrological Services' *Pilot of Arctic Canada.*

against itself. Weathered by wind-driven snow, this debris forms rounded hills called hummocks. Ice of sufficient thickness, fractured by wind, tide, and currents and then driven in on itself by these same forces, may create a huge riprap of rubble, 20 to 40 feet high and extending as far below the ice, called a pressure ridge.

Wind and current affect sea ice formation to such an extent that very little smooth ice occurs anywhere in the Arctic except in bays and along shallow coastlines. In spring the ice surface develops puddles and melt holes (often at old aglus) and a complex pattern of surface drainage. Second-year ice is likely to produce needle ice at the bottom of these melt pools, sharp spikes diligently avoided by men, dogs, and bears. In the upper layer of first-year ice that has been drained of brine candle ice sometimes forms, which tinkles like a glass chandelier as it collapses before a gust of wind or at the touch of a hand.

Because sea ice responds to wind and current and because winds and currents have predominant patterns, researchers look for the same kind of sea ice to form in the same places every year. In Coronation Gulf, where winds and currents are light, the ice may be unusually smooth for many miles in every direction. In Nares Strait (Kennedy Channel, Hall Basin, and Robeson Channel) between Ellesmere Island and Greenland, multiyear ice driven down from the north piles up in ridges 80 feet high, a violently fractured landscape that extends north and west to the extremely rugged ice of the Lincoln Sea.

The variety of ice types and the many patterns of its fracture and dislocation amaze a first-time visitor. What could become as ordinary underfoot as soil or rock remains as exotic as the surface of another planet. When nilas sags beneath you, your legs have no idea what to do. If you are forced to cross a series of pressure ridges with a heavy sledge, or must fight constantly to keep a small boat from being crushed in moving pack ice, you have difficulty imagining any landscape more exhausting or humbling.

Flying over the ice is an easy way to appreciate its tectonic activity on a larger scale, to better understand it as the never-quite-settled surface of the Arctic Ocean. From above, the finger-rafting of huge, transparent sheets of nilas seems like a delicate and regular joinery of panes of glass. The rafting of sheets of young nilas creates a pattern of scattered, altostratus-like shapes. Dark ice cakes below prove to be ones covered with epontic algae and flipped over by animals, or places where walrus have hauled out, rested, and defecated. Long streaks of gray-white ice cutting across a broad, snow-covered expanse show where leads have recently frozen over. A low pressure ridge may lead to a dark hole and a patch of reddish snow, a polar bear kill. Streamers of grease ice in patches of open water line up with the wind. In winter the leads steam with frost smoke where the (relatively) warm water meets the frigid air.

A geometry of lightning-bolt-shaped leads, of long black ponds, jagged rills, and ridges of debris that meander like eskers stretches as far as light and the atmosphere let you see. In a wide lead, small floes roll slowly off the wind to the right, on a heading of 30° to it. (All windblown ice in the North behaves this way because of the coriolis effect, the tendency of a moving body on the earth's surface to drift sideways because of the earth's rotation.)

Because of the constant, accordian-like adjustment of the ice surface, there is always open water in the Arctic Ocean, even in the coldest weather. Along the coast, where a band of stable, shorefast ice forms, a predictable flaw lead often separates shorefast ice from the moving pack, particularly when offshore winds are blowing. (This flaw zone is a regular highway for sea mammals and the most heavily hunted area of the sea ice by both bears and men.)

In addition to these flaw leads and the numerous leads that open and close regularly in the pack, there are relatively large areas of persistent open water called polynyas that stay open all winter. They are maintained by unique current and wind patterns and

occur in the same places year after year. Depending on their size and location, polynyas can harbor significant concentrations of overwintering seabirds and marine mammals. (The whaler's West Water in Baffin Bay was actually the southern end of the largest polynya in the North American Arctic, the North Water.)

SHOREFAST ice, embayed ice, or sea ice that has formed in regions where there are no appreciable currents can offer a serene and dependable surface over which to travel, even at night. Pack ice, the ice beyond the flaw lead, holds a different sort of attraction because of its constant motion, varied topography, and the access it provides to certain animals. But to venture out there on foot is, to put it simply, to court death. Pack ice moves irregularly before the wind, and the change in orientation of an individual piece of ice is unpredictable. Commonly, especially on larger pieces of ice, there is no sensation at all of movement or change. A person might discover suddenly that he was far from shore, or realize he had no idea of his position. In every coastal village from Inglefield Fiord to Saint Lawrence Island there is a story of someone who got caught out there by mistake, often pursuing a polar bear, and who was never seen again.

The crushing power of moving pack ice is not a great threat to people traveling with dogs or on foot. They can usually move nimbly enough over its surface. To be at its mercy in a boat or small ship, however, is to know an exhausting, nerve-wracking vulnerability. In May 1814, with his whaling ship beset off the east coast of Greenland, William Scoresby set out on foot to reconnoiter the final mile of maneuvering that he hoped would set him free. Like many men caught in such circumstances, Scoresby was terrified. But he was mesmerized as well by the ice, by its sheer power, its daunting scale, the inexorability of its movement. The sound of its constant adjustment before the wind was like "complicated machinery, or distant thunder," he wrote. Even as he sought a way out, he marveled at the way it distracted him. He lost the sense of plight that spurred him, the pleading whining

that came from his ship's pinched hull; he became a mere "careless spectator." It was as though he were walking over the. back of some enormous and methodical beast.

The sea ice was a more perilous environment in the era of wood ships than it seems today from the bridge of a steel-hulled icebreaker, but no arctic sailor was or is ever at ease in it. The whalers forced their way in with poorly fitted ships and lived for months at the extreme limits of their ability to cope. To get through a stretch of ice and out to open water, or to survive in a stream of ice driven down on them in a storm, nineteenth-century sailors had to employ several operations. With a favorable wind and an ice-strengthened prow, they could "bore" their way through, following the shouted directions of a lookout in the crow's nest. But a sail ship has no reverse, no reliable "dead slow," no instant "hard-to-port" response. More often they had to take the ship in tow behind their whaleboats and row through the ice. Or "warp" it forward, winching from the windlass against anchors set in the ice ahead. Or "mill-doll," by dropping a boat with three or four men from the bowsprit, to fracture ice in advance of the prow.

In the shifting pack, even a 250-ton ship could conceivably be crushed in two or three minutes, forced up in the air with an explosion of its oak ribs and driven under with a grunt, like a grand piano caught in an industrial press. To protect it during a storm in the ice front, or at night when they could not find open water, the crews sawed temporary docks in the floes. As often as not they lost that protection and had to begin all over again the wearying task of cutting and removing blocks of ice. In heavy weather the pack moved like a jigsaw puzzle; loose ice hit them repeatedly, "hard enough to knock the ship's brains out." Officers tried to mete out a crew's strength over the course of a storm, or until they got out of the ice. But any situation could change instantly—ice at rest one minute was moving the next. Officers felt the strain of unceasing responsibility and vigilance. "During that time," wrote one captain of a harrowing seventeen hours he spent running a shore lead, "I did the heaviest smoking of my life. I

smoked twenty-two cigars and numerous pipes, and I had coffee brought to me every hour. I don't know whether it was the tobacco or the coffee that brought us through, but we made it with no damage."

Damage was routine, some of it serious. "Relays of men at the pumps and others working with buckets," wrote a captain of his stove ship, "succeeded in raising seven to eight tons of water per minute, [but] the sea came in quicker than it could be thrown out." And the sea was a frigid 3o°F. They fothered their broken hulls with wads of sail and filled the cracks as well as they could with cordage and oakum. They sought a desperate protection up-current of icebergs.* But the icebergs sometimes disintegrated and the ships were swamped or crushed. Once a storm passed and the menacing ice was still, they no longer had to lie in their bunks and listen to the "rending, crashing, tearing noise," the screech and detonation of a ship's timbers. But until they were clear of it, its capricious and unappeasable nature preyed on their imaginations.

If it got very cold, as often happened toward the end of the whaling season, ice might congeal around a ship, creating in only a few hours "a crystal pavement by the breath of Heaven cemented firm." Then a man stood on the deck in such stillness, he could hear his watch ticking in his pocket. Men who had collapsed at the pumps or lost their appetites when ice peeled the copper sheathing off the ship's bottom now went out on the ice for a stroll and flew kites or tossed a ball, as though they were on a commons.

When a ship was seriously beset, the crew packed their belongings, set them on deck, and waited. The slow compression of the ship could go on for weeks before the keel finally broke or the holds flooded. When a ship was lost, however, it rarely sank right away—the men had time to step overboard and walk away, if

* Icebergs, because of their deep keels, move with the current, while sea ice moves before the wind. An iceberg can therefore plow a course through oncoming sea ice, providing shelter for a ship in its wake.

they were lucky, to another ship. In the fall of 1777, more than 350 such shipwrecked men, whalers and sealers, were to be found hiking over the ice off the southeast coast of Greenland. About 140, given food and clothing at native settlements, eventually reached Danish villages on the west coast. The others perished. In 1830, so many ships were destroyed in Melville Bay (the place they called "the breaking-up yard") that at one point nearly 1000 men were camped on the ice. Legally under the command of no captain, they set fire to the broken ships and milled about for weeks in drunken celebration. (Not a man was lost in this weird catastrophe.)

Five years later an isolated group of British ships, fishing too late, became for the first time irrevocably beset in Baffin Bay. The men had neither proper clothing nor food enough to see them through the winter. Most died of starvation, exposure, and despair during the four months they were carried passively south in the Canadian Current. The ships' logs are poignant. On November 11, 1835, an officer of the *Viewforth* wrote: "Weather milder. A great many fish have been playing around the ship to-day, amongst which we observed unicorns and white whales. We are now to the southward of Cape Searle, a sublime object. The moon has been in sight all day—it never sets—a thing I never saw before." On November 13 a mate aboard the *Jane* wrote: "Strong breezes with snow; heavy press, ship suffering greatly, how she can bear it God only knows. It's awful work; long dark nights, no hope for us if she goes. May God preserve our shelter."

When they reached the ice front in February, the floes opened and then closed, opened and then closed on them. Each day they built up their hope from scratch. One of the whalers sank. When the others were finally released, too few men were still alive aboard some of the ships to hoist sail. They drifted aimlessly in weather so foul that for days on end they could not take a bearing or fix their position. Some were met by outwardbound whalers; miraculously, every ship eventually reached England. The follow-

ing year, a dozen vessels froze in again. Half these ships sank, and the loss of life was extensive—forty-four of fifty-eight aboard the *Dee,* forty-two of forty-nine aboard the *Advice.*

Sometimes it was over very quickly. At 3:30 A.M. on the 26th of April 1832, the whaler *Shannon* of Hull, running before a southeast gale, slammed bow first into an iceberg. The captain ran forward in the darkness and laid his hands to the wall of ice even as it continued past them, ripping open the ship's starboard side. They were awash in minutes. Sixteen men and three boys were swept away. The survivors clung to each other beneath a sail, on a part of the ship kept afloat by trapped air. They were without food or fresh water. They survived, with the death of but three more, by bleeding each other and drinking the blood from a shoe. A man who left their deck shelter to commit suicide spotted two Danish brigs on the 2nd of May. The survivors, save the captain, were all frostbitten. "The rescue," writes a historian of the arctic whale fisheries, "was one of those providential affairs of which many instances could be related."

I think of a final image of devastation: the remnant of several whaling crews found in a frozen stupor behind a sea wall of dead bodies, stacked up to protect them from the worst of the heavy seas in which their small floe rolled and pitched.

The horror and loss of life are remote from us now. Our assessment of arctic seas is today more often made from an airplane, amid the crackle of constant radio contact, or from the warm bridge of an icebreaker, guided by the lugubrious movement of a gyrocompass and the deep-space silence of satellite navigation systems. This machinery compresses time and space, and comforts us because of the authority with which it keeps danger at bay. From these quarters, its scale reduced, we appraise the landscape very differently.

Few men in northern ships today, however, are without regard for the human history that preceded their own in those waters. And no arctic ship's master, his Lloyd's of London Ice Class IA Super ship boring through four feet of sea ice at a steady

five knots, sleeps free of the stories that have been passed down. They are ignored only by men for whom the recalcitrance of the land is but a distraction, a disturbance to be quelled by machinery.

The frozen ocean itself still turns in its winter sleep like a dragon.

MAX Dunbar, a pioneering arctic oceanographer, has described the Arctic Ocean with some wistfulness. Because of a paucity of seismic and magnetic research, and a lack of core samples from the seabed, the evolution of the Arctic Basin is a puzzle; and because so much of its waters are covered with ice, the Arctic Ocean remains the least understood of the world's seas. Its waters are relatively sterile when compared with those of the highly productive subarctic seas. Their lack of productivity, however, is not due to coldness or to lack of light as much as to the water's vertical stability. Without an upwelling of inorganic salts (phosphates, nitrates, and silicates) from the bottom, a rich life in the sunlit upper layers cannot be sustained. (The lack of any endemic genera, the low number of plankton species, and small plankton populations are all signs of the ocean's youth as well as its sterility, in Dunbar's view.)

Oceanographers divide the Arctic Ocean into five regions, according to the relatively few species of life to be found in each one. Farthest north is the high Arctic abyssal region, perpetually ice-covered and least known. Between there and the coasts lies a high Arctic shallow region of drifting annual ice, which enjoys periods of summer sunshine and some upwelling. Along the North American and Eurasian coasts is a brackish water region, a zone of fluctuating temperatures and salinity due to a tremendous outpouring of freshwater rivers from the northern rims of the two continents. (More meltwater flows in spring from the Lena into the Laptev Sea than from any other river in the Northern Hemisphere.)

Most of the Arctic is without tide pools and that array of life typified by the presence of sea grasses, kelp, and barnacles, because

the near-shore bottom is scoured by ice every year. Some areas, however, do harbor small populations of intertidal creatures, and these constitute a fourth zone, the Boreal littoral faunal region. Soviet scientists, far and away the most experienced of arctic oceanographers, also recognize a fifth zone between brackish coastal waters and the high Arctic shallow region, which they call the low Arctic shallow region (essentially a broad shelf sea, the continental shelf north of Russia being the most extensive sea shelf in the world).

The life of the polar seas is structured around a spring bloom of epontic phytoplankton that initiates a period of active feeding by herbivorous zooplankton. Carnivorous zooplankton, various crustaceans, and a small number of fish species, principally polar and arctic cod, extend this food web, as we have seen.* The sea ice prevents 99 percent of the sun's light from reaching these active layers of the water, but it also insulates creatures in the food web from the extreme cold of winter, and it has profoundly shaped their evolution and development. The Arctic Ocean, in fact, cannot be explained ecologically without taking the sea ice into account. Because of this, many oceanographers have come to regard the Arctic Ocean as unique, a landscape that requires a special point of view.

The foundations of Western ecology were laid down by scientists working almost exclusively with temperate-zone ecosystems. The violent fluctuations characteristic of arctic ecosystems played no role in their original conceptions, and certain conditions that typify arctic ecosystems were treated as impediments rather than normal circumstances for the development of life. Snow and ice, for example, were at first regarded as temporary

* Arctic fish have adapted to their unusual circumstances in several striking ways. The mouth of the arctic cod opens forward and up, allowing it to feed on the underside of the ice. Because of low light conditions the eyes of arctic species are somewhat larger, and because cold water is denser than warm water, arctic species also tend to be stronger swimmers than their southern counterparts.

and relatively unimportant conditions in the environment, not as integral components of the ecosystem. Snow, however, proved to be as fundamental in shaping an animal's life in the Arctic as rainfall is in the Philippines or sunlight in the Arabian Desert. It creates the stable platform from which certain animals reach browse unreachable in the summer. It forms the barrier that, more than cold temperatures, sends seed-eating birds south in the fall. It provides cover for the ermine and other weasel-like animals that plunge into snow at the approach of a predator and burrow long distances through it without surfacing. It provides insulation for ptarmigan, which dive into it in the evening to sleep. It provides the contours that conceal predators from their prey; at the same time, it founders predators and allows longer-legged and broader-footed prey to escape. It shelters a creature like the lemming, too small to grow hair long enough for insulation and still be able to walk. It creates a greenhouse effect for some plants in the spring and protects them from drying winds in the winter. It is snow that determines that a ground-dwelling squirrel that cannot migrate must hibernate, while an arboreal squirrel, living high above the ground, can remain active all winter.

Winter, not summer, is more the season of record in the Arctic for the evolutionary biologist. A northern ecologist looking at snow sees an element as integral to the landscape as soil. It is snow that cuts some animals off from their food, makes heavy energy demands on others, and insulates a third group.

Ice, to the ecologist, is but an extreme form of snow, and it alters the landscape and affects the lives of animals in ways as profound and subtle. The quality and type of sea ice are as crucial in shaping the lives of arctic marine mammals as topographic relief and the presence of plant food are in directing the movements of land animals. Seals and walrus depend on the ice to carry them passively to new feeding grounds and to function as a platform upon which they can rest, molt their hair, and give birth to their young. Ice floes also serve as temporary islands where these animals are safe from orcas and landbound predators. As a seaward extension of the

land, the ice becomes as a winter highway for migrating muskoxen, caribou, polar bears, and arctic foxes. Icebergs and large remnant pieces of pressure ridges that ground in coastal bays and continue to shift in the tides all winter, can keep enough water open to maintain a herd of walrus at a new feeding ground until spring. In November, after a river has frozen over and its channel has drained (no water flows into it after the watershed above freezes), you can sometimes drop through the ice and walk around on the empty riverbed—one of the polar bear's favorite places for a winter bivouac.

The most dramatic association between ice and arctic life, perhaps, and still largely an unexplained mystery, involves events at polynyas in winter and spring. Polynyas occur both along the coast (long, narrow shore polynyas) and at sea (more lakelike, flaw polynyas). The open water, which occurs in the same places every year, offers an overwintering refuge to some animals and a staging ground to other animals migrating north in the spring. (The consistent pattern of open water has no doubt been crucial in shaping the migratory routes of many seabirds and marine mammals.)

Polynyas are kept free of solid ice all winter by a complex interaction of forces—prevailing winds, currents, and tides, and perhaps local upwelling. They seem especially important for walrus and bearded seals as winter refuges, less so for ringed seals, narwhals, and belukhas. Some seabirds, such as the black guillemot, eiders, and oldsquaw, as well as Ross's gulls and ivory gulls, may also benefit by wintering in these places, though scientists are hard-pressed to explain how a food web can function in these dark, bitterly cold places.

Polynyas seem really to come into their own in the spring. The annual phytoplankton bloom may start in them as much as two months before it begins in adjacent, ice-covered areas, offering migrating colonial seabirds (northern fulmars, kittiwakes, dovekies, murres) a significant head start. Polynyas also seem vitally important as feeding areas for early-arriving narwhals and bowhead and belukha whales.

Areas of year-round open water in the Canadian Arctic. Adapted from Ian Stirling and Holly Cleator, Polynyas in the Canadian Arctic.

One cannot consider polynyas, of course, without recalling images of narwhals and belukhas fatally trapped in savssats; and the precipitate oscillations in normal sea-ice formation that can catch tens of thousands of early-arriving or molting seabirds by surprise. (In the spring of 1964, 100,000 king eiders—one-tenth of the regional population—were frozen-in in the Beaufort Sea.) A very real sense of loss in the face of large-scale catastrophe, however, can obscure how integral to the nature of northern ecosystems this

edge between life and death is, an edge the annual formation of sea ice sharply accentuates.

One fall afternoon a friend, an ornithologist, was counting migrating birds near Demarcation Bay on the north coast of Alaska, at a place called Pingokralik. On several tundra ponds he was also following the progress of three or four families of red-throated and arctic loons. Loons are unable to walk on land, and they require plenty of open water for taking off. Early in September, when the red-throated loon chicks were barely half their parents' size, the coast was buffeted by snow squalls. Within a few days the tundra ponds were frozen over. My friend emerged from his tent one morning to find a red-throated loon and its chick paddling about energetically in an effort to maintain a small patch of open water. The other parent, which had spent the night at sea, flew by every half hour or so with food in its beak, but it could no more land than the other bird could take off.

The next day it •warmed up enough so the pondbound adult could take off and the other bird could land with food for the chick. The loons—there were other families in similar straits nearby—persevered in this manner, even as the human observer was driven off to a more permanent shelter. He did not know the fate of the loon chicks (the adults may well have abandoned them). What he remembers seeing were the adults flying back and forth strongly from the sea, dark spots fading in the snow squalls. Resolute, even in the face of poor timing. Successful animals.

DURING parts of one summer I lived at the Canadian government's Polar Continental Shelf camp at Resolute, Cornwallis Island, a staging area for scientific research in the Arctic. During those weeks I was able to speak with a number of scientists—archaeologists, biologists, geologists, ornithologists; but one of my strongest memories is of an evening I spent with a retired geologist named Maurice Haycock, talking about painting. Haycock was in his eighties when I met him. He had had a long and successful career as a geologist with the Canadian government and had played the

French horn for many years in the Ottawa Symphony Orchestra. He had also traveled occasionally with the Canadian landscape painter A. Y. Jackson, both of them painting in the Northwest Territories on geological field trips.

One afternoon Haycock and I walked down to the edge of Barrow Strait together to look at a hazy apparition of distant Somerset Island, which had been lifted above the horizon in an imposing mirage. *(Puikartuq*, the Eskimo call it, "coming up for air.") We also examined a Thule campsite together. And he told me stories of his experiences in the Arctic in the 1920s, when travel was by dog sledge. He described one time in particular, of sledging across smooth coastal ice in brilliant spring weather, mile after mile. Time fell away. He experienced a detachment so peaceful, he said, that in his scientific mind he solved problem after problem. He spoke to me with the tones of someone remembering once having fallen in love. He was charming, a man nearing the end of a life of rich, authentic moments.

The evening I am thinking of, I was sitting in his room in camp. He lay on his bed with one arm across his forehead. In his other hand he held several brushes, from which he meant shortly to wash the residue of the day's efforts. He was trying to capture in words his admiration for the land. He recalled having painted once at the Grand Canyon and the trouble he had had in painting the air, the space between the south rim where he stood and the far north rim.

He was trying to speak about the difficulty of painting air. And he said he liked to paint here on Cornwallis Island, the fields of glacial till where there was hardly a plant, because he enjoyed the subtleties. "A close-toned land," he said. The brushes clicked in his hand as he rolled them against each other. He thought in silence. "The tones of the land here," he said, "are lighter than the tones of the midday sky."

As I listened, I felt the evening sun pouring through the windowpane onto the side of my head. The room was airy with sunlight, flushed, like an empty summer bedroom in one of Edward

Hopper's paintings. I could see how brightly Haycock's eyes shone as he moved through the forests of his own memory; his large, roughened hands; and the sheen on a painting he'd done that morning on a small piece of birch plywood. I was acutely aware of listening to him, though for long periods neither of us spoke. He reminisced about days painting on the tundra near Great Slave Lake with Jackson, one of Canada's radical Group of Seven, landscape painters who gained prominence for their indigenous Canadian style in the 1910s. He talked about why one went out to paint like that. It was a conversation with the land, he said.

The evening slipped quietly away from both of us. Eventually he went to wash his brushes and I went to my room and lay down to think. If I were a painter, I, too, would be taken with the fullness and subtle quality of the light here. You have the color balances from all twenty-four hours from which to choose, the sweeping lines of crisp desert vistas under huge prairie skies, and the rarefied air with which to work. Ice and water push the light up beneath cliffs and into other places where you would expect to find shadows, and back into the sky where it fills the air. At certain hours the land has the resolution of a polished diamond.

This obvious and disarming beauty, oddly, is absent from nineteenth-century European landscape paintings of the region. But the subject of virtually all of that work was British arctic exploration, and the theme was remarkably consistent—a nation blessed by God, at war with the elements in a treacherous landscape. The Arctic they painted was a place beyond the pale of civilization, a beast that preyed on virtue and enterprise. Among the most famous of these paintings are Caspar David Friedrich's *The Polar Sea* (1824), in which a ship of exploration (the *Hope,* in an early sketch) lies crushed amid huge, rafted floes; William Bradford's *An Arctic Summer, Boring through the Pack Ice in Melville Bay* (1871), in which a distant three-masted ship, although itself bathed in light, is headed for a foreground of ice overshadowed by cloud and upon which rests a cruciform fragment from another vessel's mast; and Edwin Landseer's *Man Proposes, God Disposes,* in which

two imposing polar bears are tearing apart the wreckage of yet another ship crushed in the ice.

The luminist tradition in nineteenth-century American landscape painting found itself only on the fringes of the Arctic, but it was a movement far better suited to an evocation of the North than the European tradition. Luminist painters sought out a soothing and restful light, which they found along the New England coast at places like Provincetown, Massachusetts. The art critic John Russell, alluding to the nation's mood after the Civil War, has called it "a healing light." I think of these New England paintings because the light in them, the plein-air essence of it, is a familiar light in the Arctic. As I traveled to and from Resolute, especially in the evening hours around midnight, I beheld scenes that reminded me forcefully of the work of luminists like Fitz Hugh Lane. At Cape Vera, Devon Island, one evening, the water in Jones Sound was so black and matte-finished it looked like scorched earth, and the icebergs floating in it were so brilliant my eye could not rest on their surfaces. Another time, off the west coast of Ellef Ringnes Island, the air, not the sun, seemed to be the source of a flat, breathy light, within which I saw only long, restful lines: a bare strand meeting the dark water, and the water the vacant blue of the sky. And yet again on Banks Island, at two in the morning, I saw a herd of muskoxen moving across a shallow slope of green grass in strong light, through air as bright as if it had just been washed in a summer rain, with brilliant, individual pinpoints of purple lousewort and white avens in the foreground. As in the New England paintings, it was as though "all that one beheld was full of blessing."

The evening I spoke with Haycock, I came across, in my notes about light, the words of a prisoner remembering life in solitary confinement. He wrote that the only light he experienced was "the vivid burst of brilliance" that came when he shut his eyes tight. That light, which came to him in a darkness that "was like being in ink," was "like fireworks." He wrote, "My eyes *hungered* for light, for color. . . ." You cannot look at Western

painting, let alone the work of the luminists, without sensing that hunger. Western civilization, I think, longs for light as it longs for blessing, or for peace or God.

The night I spoke with Haycock, in a building on Cornwallis Island in which no one but scientists slept (a scientific background was Haycock's entrée), I felt because of his artistic passion the great range of human inquiry. We desire not merely to know the sorts of things that are revealed in scientific papers but to know what is beautiful and edifying in a faraway place. Considering the tradition of distant travelers, the range of their interests and the range of their countrymen's desire to know, the government camp on Cornwallis Island seemed an impoverished outpost. There were no provisions there for painters, for musicians, for novelists. And there were no historians there. If the quest for knowledge in any remote place is meant in an egalitarian sense to be useful to all, then this is a peculiar situation. Yet it is no different from what one would find in a hundred other such remote places around the world. Whenever we seek to take swift and efficient possession of places completely new to us, places we neither own nor understand, our first and often only assessment is a scientific one. And so our evaluations remain unfinished.

Whatever evaluation we finally make of a stretch of land, however, no matter how profound or accurate, we will find it inadequate. The land retains an identity of its own, still deeper and more subtle than we can know. Our obligation toward it then becomes simple: to approach with an uncalculating mind, with an attitude of regard. To try to sense the range and variety of its expression—its weather and colors and animals. To intend from the beginning to preserve some of the mystery within it as a kind of wisdom to be experienced, not questioned. And to be alert for its openings, for that moment when something sacred reveals itself within the mundane, and you know the land knows you are there.

AT first it seems that, except for a brief few weeks in autumn, the Arctic is without color. Its land colors are the colors of

deserts, the ochers and siennas of stratified soils, the gray-greens of sparse plant life on bare soil. On closer inspection, however, the monotonic rock of the polar desert is seen to harbor the myriad greens, reds, yellows, and oranges of lichens. The whites of tundra swans and of sunlit ice in black water are pure and elegant. Occasionally there is brilliant coloring—as with wildflowers in the summer, or a hillside of willow and bearberry in the fall; or a slick of vegetable oils shining with the iridescent colors of petroleum on a tundra puddle; or the bright face of a king eider. But the bright colors are more often only points in a season, not brushstrokes; and they are absorbed in the paler casts of the landscape.

Arresting color in the Arctic is found more often in the sky, with its vivid twilights and the aurora borealis. (The predominant colors of the aurora are a pale green and a soft rose. I turned over a weathered caribou antler once on the tundra and found these same two colors staining its white surface. Such correspondence, like that between a surfacing guillemot and an Eskimo man rolling upright in his kayak, hold a landscape together.)

Arctic skies retain the colors of dawn and dusk for hours in winter. On days when the southern sky is barely lit for a while around noon, layers of deep violet, of bruised purples and dense blues, may stretch across 80° of the horizon, above a familiar lavender and the thinnest line of yellow gold. The first sunrise/sunset of spring may glow "carmine and lake [red], fading off into crimsons, yellows, and saffrons," as a British naval surgeon wrote in his winter journal. In the spring and fall, when sunrises and sunsets are more widely separated, vivid reds, oranges, and yellows shine through washes of rose and salmon, of pale cyan, apricot and indigo, as they do in other latitudes. In summer, the skies have a nacreous quality, like the inside of an abalone shell. The colors of summer skies are pastel; the temperature of the light, however, varies enough so that around midnight yellows in the landscape fade noticeably and blues deepen.

The striking phenomena in the arctic sky for a newcomer are the unsuspected variety of solar and lunar rings, halos, and coronas;

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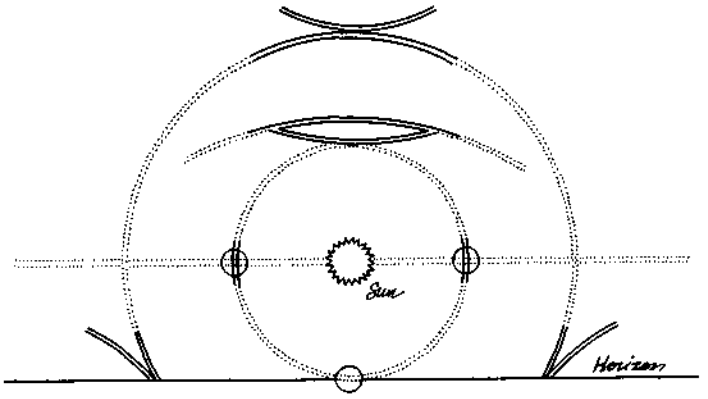
The striking phenomena in the arctic sky for a newcomer are the unsuspected variety of solar and lunar rings, halos, and coronas;

the aurora borealis itself; and the mirages that occur at sea, including fata morganas. These events are especially apparent in the Far North for several reasons. The kinds of ice crystals that cause solar and lunar refraction are often present in the arctic atmosphere. The air itself is clear. Slight inversions in the lower atmosphere and sharp temperature differentials at the surface of the ocean in summer, which cause mirages, are common. And the arctic region lies directly underneath the part of the earth's atmosphere that makes the auroral display, or northern lights, visible.

When he was in winter quarters on the coast of Melville Island in 1819-20, William Parry drew a picture of the sun's halos, arcs, and parahelia, or sun dogs, that is now famous. He captured in that single drawing many of the effects that are regularly seen in the Arctic either alone or in some combination. The sun, at the time, was about 22° above the southeastern horizon. It was surrounded by a halo that measured 44° across the horizon and by a second halo 92° across the horizon, part of which was cut off below by the line of the earth. (These are called, after their degree of radius, the 22° and 46° solar halos.) Both these halos were subtended by other arcs, while yet another arc cut across the sun and swept away east and west, parallel to the horizon (the parahelic arc). Where the parahelic arc crossed the 22° halo, two brilliant sun dogs appeared. And below the sun, just at the horizon, gleamed a third sun dog (actually a subsun).

This picture can be readily explained by physicists in terms of ray mechanics, a precise bending of sunlight through certain types of ice crystals aligned in a specific way. In fact, a physicist named Robert Greenler reproduced the elements of Parry's drawing almost perfectly in a computer illustration generated by the formulae involved—a tribute to the accuracy and completeness of Parry's work.

Francis M'Clintock, another British explorer, was presiding at a burial through the sea ice in Baffin Bay in 1857 when he took



William Parry's drawing of solar arcs and halos.

notice of a stark December moon. A "complete halo encirclfed] the moon," wrote M'Clintock, "through which passed a horizontal band of pale light that encompassed the heavens; above the moon appeared the segments of two other halos, and there were also mock moons or paraselenae to the number of six. The misty atmosphere lent a very ghastly hue to this singular display, which lasted rather more than an hour."

The physics involved in the refraction and reflection of sunlight by ice crystals and water droplets, and its diffraction by airborne particles, is dauntingly complex. The arcs and halos produced are sometimes very faint; they also occur in unexpected combinations. Seeing them, however, is largely a matter of training yourself to look. On a single spring day over Lancaster Sound I saw a soft, opaque white pillar or feather (the shape was like a passerine bird's tail feather) standing between the sun and the southeastern horizon (a sun pillar); and that evening, a few minutes after midnight, two long, rainbow-hued shields standing on

the horizon on opposite sides of the sun, an unusual pair of sun dogs.*

THE aurora borealis, pale gossamer curtains of light that seem to undulate across arctic skies, are transfixing in part because of their diffidence. "It is impossible to witness such a beautiful phenomenon without a sense of awe," wrote Robert Scott, the British Antarctic explorer, "and yet this sentiment is not inspired by its brilliancy but rather by its delicacy in light and colour, its transparency, and above all by its tremulous evanescence of form. There is no glittering splendour to dazzle the eye, as has been too often described; rather the appeal is to the imagination by the suggestion of something wholly spiritual. . . ."

It is unusual in the literature of exploration to find a strictly consistent reaction, but virtually everyone who wrote down his thoughts about the aurora described, first, the inadequacy of his language and, second, a pervasive and stilling spiritual presence. Among Eskimos the descriptions are often of events that precede or follow life on earth, of the play of unborn children, or of torches held by the dead to help the living hunt in winter. In more southerly latitudes of the Northern Hemisphere, where the aurora is occasionally visible, its connotations are much different, largely because its predominant color when it becomes visible that far south is a deep red. The apparition suggested conflagration and holocaust to Europeans in the Middle Ages. Vikings thought it a reflection in the sky of Vulcan's forge. Miners in Alaska at the

* Once I developed the habit of looking into the "empty" part of the arctic sky opposite the sun, and at sections of the sky that spanned more than 60°, I began to notice much more in temperate-zone skies—the mother-of-pearl iridescence of the sun's or moon's corona in clouds, for example, or noctilucent clouds in the stratosphere late in the evening. The most complex and spectacular display of solar arcs and halos I ever saw was in the winter sky over Los Angeles. At first, out of the corner of my eye, I thought they were only wind-distorted jet contrails. I almost didn't look up.

turn of the century, of a more scientific and prosaic bent, thought the aurora was a gaseous form of lightning or the glow from radium mines.

The first time I recognized the northern lights was on a flight from Seattle to Anchorage, when I saw them above the Wrangell Mountains. It was a clear night, and at first I thought it was only a long, moonlit orographic cloud, the kind one often sees isolated over a mountain. Then I saw it move. Completely absorbed, I watched the long banner of pale light, unfurling in lateral movements over the snow-white mountains until the plane turned away. The motions were like a t'ai chi exercise: graceful, inward-turning, and protracted.

The bottom of an auroral display rarely comes as close as 100 miles above the earth. To the human eye, however, the thin wall of light sometimes appears actually to touch the earth because of a problem of depth perception with objects of unknown size in space. Accurate descriptions are further complicated by its overwhelming size, and its movement. The light wall is often hundreds of miles long and 150 miles or more high; as the intensity of auroral activity increases, the "curtain" of light begins to undulate in a horizontal direction, folding back on itself in huge S-curves and then unfurling again.

There are additional problems with perspective and scale. To someone underneath the display (the top of the wall is tipped toward the south), the aurora may appear like a convergence of rays toward an apex above. Seen edge-on (from directly beneath the bottom edge), the display may seem like luminous smoke rising from the earth. From a distance it may look like a weightless curtain of silk, hanging straight down and rippling in the night air.

The aurora occurs in a thin corridor called the auroral oval centered on the North Magnetic Pole. The display is created by an electric discharge in the earth's ionosphere and is apparent to us because some of the energy released is visible light. The most common tinting, of pale, whitish green and pinkish rose, is light emitted from oxygen atoms. During intense periods of auroral

activity, nitrogen molecules release a crimson light, usually apparent only at the bottom edge of the auroral curtain.

Imagine that your view is from the sun and that you are facing the earth. To your far left on the earth's surface are the penumbral shadows of dawn. Before you is the bright light of noon. To your far right the border between evening and night. Streaming outward from the sun is a gas of ionized, or charged, particles, mostly helium and hydrogen nuclei, called the solar wind. These particles pass around the earth as though it were a rock in a stream of water. In doing so they flatten the planet's magnetic field (the magnetosphere) on the near side (day) and elongate it on the far side (night). As it flows past the earth, the solar wind generates an electric current from left to right. The path of least resistance for the solar particles that carry this current is along force lines in the earth's magnetic field that curve down to the earth's surface in the polar regions (like the embrasure of an apple, where the stem is). Particles pouring into the polar regions from a positive terminal on the left create the aurora. As they flow up and out to a negative terminal on the right, they constitute a separate invisible phenomenon, the polar wind.

As the stream of particles flows earthward down the funnel-shaped surface of the magnetosphere at the Pole, it excites electrons in oxygen atoms and nitrogen molecules which, as they settle back into a stable state, emit energy—X rays, infrared and ultraviolet light, radio waves, and visible light.

The still wall of light we perceive curved along an east-west arc is the calmest sort of auroral display. The more energetic the sun's streaming particles, the deeper they penetrate into the earth's ionosphere and the taller the wall of light becomes. Varying intensities in the electric field produced by the solar wind, and in the solar wind's own magnetic field, cause the wall to develop a series of fine corrugations and folds perpendicular to its east-west extension, to surge in several directions, and to break up into patches. The changes in the electric and magnetic fields that produce, respectively, the changes in color and motion are caused by

magnetic storms on the sun. Major magnetic storms occur in an eleven-year cycle, in association with solar flares in the vicinity of sunspots and in solar features called coronal holes. Magnetic substorms, far more common, create the sequence of auroral events that arctic viewers think of as "typical" for an arctic winter evening. First, a sudden brightening resolves itself into a transparent auroral curtain. Its fine corruscations (rays) become more prominent. There are surges of movement east and west across the curtain, which starts to develop deep folds. The entire display may then move steadily north. Toward dawn it breaks up into isolated luminous patches, like clouds.

The power produced in this generator is astonishing—i trillion watts with a current of i million amperes. The most violent solar storms affect magnetic compasses, wreak havoc with radio communications and certain navigational systems, and create induced electric currents in long conductors like the trans-Alaska pipeline.

Many people claim the aurora makes a sound, a muffled swish or "a whistling and crackling noise, like the waving of a large flag in a fresh gale of wind," as the explorer Samuel Hearne wrote. And some Eskimos say "the lights" will respond to a gentle whistling and come nearer. They easily evoke feelings of awe and tenderness; the most remarkable effect they seem to have, however, is to draw a viewer emotionally up and out of himself, because they throw the sky into a third dimension, on such a vast scale, in such a beautiful way, that they make the emotion of self-pity impossible.

I remember flying from Prudhoe Bay to Fairbanks one winter night. The sky was clear and the aurora borealis was very strong. With moonlight from the south the snow-covered landscape below was bright, its relief evident in ground shadows. Even the faint line separating the snow-covered tundra from the snow-covered ice was apparent. The auroral curtain stretched out to the west from my view, toward the village of Wainright and the Chukchi Sea. It was in its early, quiescent form of diaphanous rays, a long, pale ghost fire. I could see the edge of the Brooks Range and the plain

of the North Slope below. I recalled days of camping in the mountains, of traveling on the tundra, and the times I'd camped on the arctic coast west of Prudhoe. I could see these places clearly, but it was the aurora, towering over the earth, that resolved what could have been only a map into a real landscape, making the memories seem immediate and tangible.

No one knows whether the first Europeans found their way to Iceland, and thence to Greenland and North America, by accident or by design. A reasonable thought is that Iceland occasionally appeared to people in the Faroe Islands as a great looming mirage, like the one of Somerset Island I saw that day. Such mirages often occur whenever a mass of warm air lies over a body of cold water. Light rays that under other conditions might travel straight off into space are bent, or refracted, back earthward in a series of small steps as they pass through layers of air at different temperatures.

Mirages are usually divided into two categories: in superior mirages, like the one of Somerset, the image the eye sees of an object is a false image above the actual object; in an inferior mirage, the false image occurs below the object. Superior mirages are commonly seen at sea in the Arctic in summer, especially late in the afternoon of a clear day. Distant islands, ships, coastlines, and icebergs lying beyond the real horizon all appear to be closer than they are, the sea itself appears slightly concave, and the horizon seems unusually far off.

Superior images are created when light waves pass from denser (or cooler) air in the lower atmosphere into air that is less dense (or warmer). Evenly spaced layers of successively warmer air (i.e., layers of air arranged in a perfect temperature gradient) work like a series of eyeglass lenses, each of which is successively less corrective. A ray of light passing through them all is bent back earthward in a smooth arc. The viewer sees a single clear image of the real object.

If the lenses are arranged, however, so that a more corrective lens comes between two less corrective lenses, the ray of light is turned back on itself. If it is turned back sufficiently (e.g., because of a strong temperature inversion in the lower atmosphere), a viewer will see not only the primary image but a second, inverted image on top of it. Another series of corrective lenses "out of sequence" (i.e., a second temperature inversion in the lower atmosphere) will create a third image, this one right-side-up on top of the second image. With other changes in the order of the lenses, the primary image itself will disappear entirely, leaving an empty space between the horizon and the second, inverted image.

The degree of "stooping" (the vertical compression common with superior mirages), as well as the number of images that appear, and any apparent magnification of the image, depend on the rate of change of air temperature vertically and the presence of reversals in that rate of change. Mirages, of course, are always imprecise. The distortions come about because of shimmering (due to slight turbulence in the air) and because the entire atmospheric lens itself is astigmatic—it curves more strongly in one direction (vertically) than the other (horizontally). All mirages, therefore, are vertically fuzzy. It is this astigmatic quality of the atmosphere, in combination with complex atmospheric inversions above uniformly bright objects like the sea ice, that gives rise to the most impressive of arctic mirages, the fata morgana. These extensive "mountain ranges" or "urban skylines" seem utterly real to the soberest viewer because of the combined effect of several optical phenomena.

Under mirage conditions, sunlight reflecting off the sea ice, through layers of successively warmer air, in which there is a sequence of slight temperature inversions, creates the appearance of a high grayish rampart in the distance. The wall appears in outline and detail exactly like a distant palisade seen through the earth's blue haze because the astigmatic atmospheric lens has broken the white ice up into areas of light and shadow, and

vertical blurring has eliminated any recognizable features. If the layers of air are then slightly tipped by a breeze and return to the horizontal in a regular rhythmic pattern (which occurs because of gravity), the alternation will produce permanent peaks and spires on an already steady image and the illusion is complete. The upper edge of the mirage appears serrated, like the arête of a mountain range; the gray walls suggest snow-covered slopes, even down to dark ridge lines where wind has apparently blown the snow away; and the clefts of steep montane valleys are apparent.

Mirages were a source of delight and amusement to many arctic travelers. They brought lighthearted feelings and a sense of mock astonishment to the serious, sometimes tedious business of making coastal surveys and plotting a course. Fata morganas stand somewhat outside this tradition of innocent whimsy. Seasoned explorers, vehemently insisting on what they had seen, set down mountains and islands on their charts where there was nothing but empty sky. So convincing were these apparitions that the skepticism of other explorers (or even a member of the same expedition) was met with contempt. Expeditions sent out later to verify these new lands sometimes saw the same fata morgana, further confusing the issue. Only by prolonging their arduous journeys, thereby observing a constant receding of the image, did they prove that the land was not there at all.

So it was for the Macmillan Expedition (1913), sent to confirm the existence of a "Crocker Land," reported by Robert Peary northwest of Cape Thomas Hubbard, northern Axel Heiberg Island. The "Barnard Mountains," reported by John Ross in 1818 to extend from Devon Island to Ellesmere Island across Jones Sound, were found not to exist by Edward Inglefield in 1852. American explorer Charles Francis Hall's "President's Land" proved an ephemera. The "King Oscar Land" and "Petermann Land" described by an Austrian army officer from Cape Fligeli, Franz Josef Land, in 1884 were never seen again. Vilhjalmur Stefansson set off twice in search of "Keenan Land" in the Beaufort Sea.

Some arctic experts conjecture, especially in Stefansson's case, that these fata morganas were actually tabular bergs or ice islands. It may, indeed, have been a tabular berg hundreds of square miles in extent that a Cossack explorer named Alexei Markoff found far north of the Yana River delta in 1715. The "prodigious mountains" of ice that blocked his path were never reported again.

THE monotonic surfaces of the Arctic create frequent problems with scale and depth perception, especially on overcast days. Arctic hare and willow ptarmigan sometimes disappear against the snow when they are only two or three yards away. Even when a contrasting animal like a caribou or a brown bear is visible on snow or ice, it is sometimes hard to determine whether it is a large animal at a distance or a small animal at close range. In *My Life with the Eskimo* Stefansson recalls spending an hour stalking a tundra grizzly that turned out to be a marmot. A Swedish explorer had all but completed a written description in his notebook of a craggy headland with two unusually symmetrical valley glaciers, the whole of it a part of a large island, when he discovered what he was looking at was a walrus. Johann Miertsching, traveling with M'Clure aboard the *Investigator,* wrote of a polar bear that "rose in the air and flew off" as the hunting party approached. A snowy owl. "These comical deceptions," wrote Miertsching, "are a frequent occurrence."

The white-out is another familiar deceptive phenomenon. It commonly occurs under an overcast sky or in a fog bank, where light traveling in one direction at a certain angle has the same flux, or strength, as light traveling at any angle in any other direction. There are no shadows. Space has no depth. There is no horizon. On foot you stumble about in missed-stair-step fashion. On a fast-moving snow machine your heart nearly stops when the bottom of the world disappears.

William Scoresby, in his *Account of the Arctic Regions* (1820), offered an original explanation for mistakes in depth perception that are frequently made along certain arctic coasts. The

coasts he had in mind are characterized by an extreme degree of contrast between their barren rock walls and expanses of snow and ice. With no middle tones to work with, the eye has trouble resolving these two-dimensional vistas into three dimensions. The human eye also commonly uses the relative density of blue light scattered in the air to judge distance (this is the light that softens the edge of a far mountain); but the clear arctic atmosphere scatters very little light. Faced with these high-contrast, black-and-white coasts, having no knowledge of their real height, and staring at them through an exceedingly clear atmosphere, early mariners had no idea whether they were 5 or 25 miles offshore. Mogens Heinson, sent out to search for lost colonies in Greenland by Frederick II of Denmark in the sixteenth century, battled ice and snow squalls across the North Atlantic for weeks before he raised Greenland's southeast coast. With a fresh gale blowing favorably and clear skies, he laid a course for those towering cliffs. After several hours he appeared to be no closer to the coast than when he began. The effect was so convincing that he succumbed to the belief that his ship was being held motionless over an undersea lodestone. Frightened, he put about until the coast of Greenland was far behind, and then set course for Denmark.

IT is my habit when I travel to note resemblances, particularly of form and color. For example, that between the bones of a lemming and a strand of staghorn lichen next to it on the tundra. Or the sound of a native drum made from walrus intestine and its uncanny resemblance to the underwater voice of the walrus. Or between an object I have never seen before and objects I am familiar with—the head of an arctic hare's rib and the rainspout gorgons of cathedrals. Scoresby's observation is memorable; a pure contrast of black and white draws much in the Arctic together. Sunlit icebergs on a matte-dark sea are a very common example. But I also remembered this point when looking up to see arctic hares feeding on a shadowed hillside. Or any of the white summer birds against dark hills or soil—ivory gulls and tundra

swans. Or the other way around—black guillemots flying over the white ice. Or any of the arctic birds in which the black-and-white pattern is so apparent—snowy owl, snow bunting, dovekie, common loon, snow goose. The black bowhead with its white chin patches. Walrus on an ice floe. Leads in the spring ice.

The startling contrast in these images became a reminder for me of the tendency to register only half of what is there in a harsh land, to ignore the other part, which is either difficult to reach or unsettling to think about. The dim-lit ocean beneath the ice, so difficult of access, remains unknown, as do the winter lives of many of the animals and plants. The ice life of the ribbon seal is known, but not its pelagic life. The beautiful throat-singing of the Eskimo, *katajak*, is heard by the winter visitor but not the shouts of a shaman bound by his helpers with walrus-hide cord and "traveling" in a trance. Caribou moving through the Ogilvie Mountains like wood smoke in a snowstorm, that image, but not the caribou cow killed by ravens in her birthing.

I would remember a flock of jet-black guillemots, streaking low over the white ice.

In the middle of summer, lying on my back on the warm tundra, I would think about the winter, because the summer by itself was so peaceful and I was trying to understand how the *ivhole* landscape fit together. Winter, with its iron indifference, its terrible weight, explained the ecstasy of summer. The effects of winter were disquieting to contemplate. Not the cold, though that could make you •whimper with pain; it could, they would say, make rocks give up and shatter. Not the cold but the oppression. The darkness that came down. The winter wind that picked up a boat in a village and pitchpoled it across the frozen beach, as if darkly mad. The oral literature of the Eskimo is full of nightmare images from the winter months, images of grotesque death, of savage beasts, of mutilation and pain. In the feeble light between the drawn-in houses of a winter village, you can hear the breathing of something with ice for a heart.

I remember a January in Fairbanks when the temperature

stayed around —45 °F for a week. Any bit of moisture in the air turned to crystals, creating an ice fog. It is haunting and beautiful to see the exhalations of a herd of caribou hanging over them like a cloud in that cold, or breath trailing behind a gliding snowy owl. But in Fairbanks, where the fog from furnaces and cars and wood fires was suspended just above the streets, it was oppressive. It blurred the edges of buildings and muffled the sound of the already obscure passing car. Snow as hard as concrete took the curbs away from the streets. In the witless gray light, huge ravens walked the alleys behind stores, tearing at bits of garbage. They hunkered on the tops of telephone poles in the white vapor, staring down, cawing that ear-splitting caw. I never felt anything so prehistoric.

Winter darkness shuts off the far view. The cold drives you deep into your clothing, muscles you back into your home. Even the mind retreats into itself.

In winter I try to remember the spring: light so brilliant the eyelid by itself is no protection. You sleep with a strip of felt tied over your eyes. (I would think of Winifred Petchey Marsh, wearing snow goggles with thin slits while she painted on the tundra at Eskimo Point, because sunglasses distorted the colors.) Of air so clear, a vista so open, you thought you would be able to see Iowa from the banks of the Colville, with just a little elevation. But in winter I would also dwell on darkness. A kind of darkness, for example, that afflicts the Kaminuriak caribou: excess killing at the hands of Eskimos, in modern times. Everyone is afraid to say something about it, for fear of being called a racist. It is easier to let the animals go than to confront that tenebrous region in ourselves. The darkness of politics, in the long hours, runs into the darkness of the land. Into anger.

I would think of the Eskimo. The darker side of the human spirit is not refined away by civilization. It is not something we are done with. Eskimo people, in my experience, have, still, a sober knowledge of their capacity for violence, but are reluctant to speak of it to whites because they have been taught that these

are the emotions, the impulses, of primitives. We confuse the primitive with the inability to understand how a light bulb works. We confuse the primitive with being deranged. What is truly primitive in us and them, savage hungers, ethical dereliction, we try to pass over; or we leave them, alone, to be changed. They can humiliate you with a look that says they know better.

In the modern ironies of a remote village—satellite televising of game shows, a small boy wearing a Harvard sweatshirt, pasta for dinner with cloth napkins, after a sermon in the Baptist church about the scourge of Communism—even here, especially here, it is possible to catch a glimpse, usually in the preparation for a hunt, of the former power, the superhuman strength and unflinching intensity, of the *angakoq.* He is an intermediary with darkness. He has *qaumaneq,* the shaman light, the luminous fire, the inexplicable searchlight that enables him to see in the dark, literally and metaphorically. He reaches for the throat of darkness; that is the primitive, as primitive as an explosion of blood. Out hunting, in the welter of gore, of impetuous shooting, that heady mixture of joy and violence, sometimes it is possible for an outsider to feel the edge of the primitive. Unbridled, it is frightening. It also defeats starvation. And in its enthusiasm for the concrete events of life, it can defeat what weighs against the heart and soul.

Winter darkness brings on the extreme winter depression the Polar Eskimo call *perlerorneq.* According to the anthropologist Jean Malaurie, the word means to feel "the weight of life." To look ahead to all that must be accomplished and to retreat to the present feeling defeated, weary before starting, a core of anger, a miserable sadness. It is to be "sick of life" a man named Imina told Malaurie. The victim tears fitfully at his clothing. A woman begins aimlessly slashing at things in the iglu with her knife. A person runs half naked into the bitter freezing night, screaming out at the village, eating the shit of the dogs. Eventually the person is calmed by others in the family, with great compassion, and helped to sleep. *Perlerorneq.* Winter.

I would turn over a tiny Dorset mask, the anguished face, in my mind. I recall a day of errors, hunting seals in the ice of the Beaufort Sea. I felt whatever trouble we had had that day was due to my own failures of attitude, though this was self-indulgent thinking. I was skinning a bearded seal on a small ice cake with another man, in silence. The ocean—still as a pane of glass. One call only, from a loon. I thought how the ice under my feet *could suddenly melt.* I was standing on water over the water. My heart went into my neck. Later we ate. I ate the meat of the seal.

No summer is long enough to take away the winter. The winter always comes. You try to get a feeling for the proportions of a full life, one that confronts everything. An animal dies. You face two central, philosophical questions: What is death, and what is the nature of an animal? You fall asleep on the summer tundra in the streaming light. You awake to the sound of birds—plovers and Lapland longspurs. Inches from your eye, an intense cluster of Parisian blue flowers. A few inches farther a poppy nods under the weight of a bumblebee. Above, cumulus clouds as voluptuous as summer fruits. You roll over and embrace the earth.

A black guillemot flies over the white ice, and then disappears against the dark water.

DURING the sea-lift passage of the *Soodoc* north through Davis Strait, en route to Little Cornwallis Island, I got in the habit of spending afternoons in the cab of a large front-loader that was chained down on the deck alongside other pieces of heavy machinery. I could sit there out of the wind and occasional rain, looking out through its spacious windows at the sea and ice. Sometimes I would read in the *Pilot of Arctic Canada.* Or I would read arctic history with a map spread out in my lap.

The days among the icebergs passed slowly. I sat in my makeshift catbird seat on the deck, or stood watching in the bows, or up on the bridge with my binoculars and sketchbook.

The icebergs were like pieces of Montana floating past. A different geography, I thought, from the one I grew up knowing.

Icebergs create an unfamiliar sense of space because the horizon retreats from them and the sky rises without any lines of compression behind them. It is this perspective that frightened pioneer families on the treeless North American prairies. Too much space, anchored only now and then by a stretch of bur oak savanna. Landscape painting of the T'ang and Sung dynasties (seventh to twelfth centuries) used this arrangement of space to create the sense of a large presence beyond. Indeed, the subject of such paintings was often their apparent emptiness.

American landscape painting in the nineteenth century, to return to an earlier thought, reveals a struggle with light and space that eventually set it apart from a contemporary European tradition of pastoral landscapes framed by trees, the world viewed from a carriage window. American painters meant to locate an actual spiritual presence in the North American landscape. Their paintings, according to art historians of the period, were the inspirations of men and women who "saw the face of God" in the prairies and mountains and along the river bottoms. One of the clearest expressions of this recasting of an understanding of what a landscape is were the almost austere compositions of the luminists. The atmosphere of these paintings is silent and contemplative. They suggest a private rather than a public encounter with the land. Several critics, among them Barbara Novak in her study of this period in American art, *Nature and Culture,* have described as well a peculiar "loss of ego" in the paintings. The artist disappears. The authority of the work lies, instead, with the land. And the light in them is like a creature, a living, integral part of the scene. The landscape is numinous, imposing, real. It ceases to be, as it was in Europe, merely symbolic.

At the height of his critical and popular acclaim in 1859, Frederic Edwin Church, one of the most prominent of the luminists, set sail for waters off the Newfoundland coast. He wanted to sketch the icebergs there. They seemed to him the very embodiment of light in nature. Following a three-week cruise, he returned to his studio in New York to execute a large painting.

The small field sketches he made—some are no larger than the palm of your hand—have a wonderful, working intimacy about them. He captures both the monolithic inscrutability of icebergs and the weathered, beaten look they have by the time they arrive that far south in the Labrador Sea. Looking closely at one drawing, made on July 1, I noticed that Church had penciled underneath it the words "strange supernatural."

The oil painting he produced from these sketches came to be called *The Icebergs.* It is so imposing—6 feet by 10 feet wide—a viewer feels he can almost step into it, which was Church's intent. In the foreground is a shelf of ice, part of an iceberg that fills most of the painting and which rises abruptly in the left foreground. On the right, the flooded ice shelf becomes part of a wave-carved grotto. In the central middle ground is a becalmed embayment, opening onto darker ocean waters to the left, which continue to a stormy horizon and other, distant icebergs. Dominating the background on the far side of the embayment is a high wall of ice and snow that carries all the way to the right of the painting. In the ocean air above is a rolling mist. The shading and forms of the icebergs are expertly limned—Church was an avid naturalist, and conscientious about such accuracy—and the colors, though slightly embellished, are true.

There are two oddities about this now very famous American landscape painting. When it was undraped at Gaupil's Gallery in New York on April 24, 1861, the reaction was more reserved than the lionized Church had anticipated. But *The Icebergs* differed from the rest of Church's work in one, crucial aspect: there was no trace of man in it. Convinced that he had perhaps made a mistake, Church took the work back to his studio and inserted in the foreground a bit of flotsam from a shipwreck, a portion of the main-topmast with the crow's nest. The painting was then exhibited in Boston, where it was no better received than it had been in New York. Only when it arrived in London did critics and audiences marvel. "A most weird and beautiful picture," wrote a reviewer in the *Manchester Guardian.* England, with its longer

history of arctic exploration and whaling and but a few years removed from the tragedy of Sir John Franklin, was certainly more appreciative, at least, of its subject matter.

The second oddity is that Church's painting "disappeared" for 116 years. It was purchased in 1863 by a Sir Edward Watkin, after the London showing, to hang at his estate outside Manchester, called Rose Hill. It then passed by inheritance through Watkin's son to a purchaser of the estate; and then, by donation, to Saint Wilfred's Church nearby (which returned it to Rose Hill with regrets about its size). By 1979 Rose Hill had become the Rose Hill Remand Home for Boys, and *The Icebergs,* hanging without a frame in a stairwell, had been signed by one of the boys. Unaware of its value and seeking funds for the reform school's operation, the owners offered it for sale. The painting was brought back to New York and sold at auction on October 25, 1979, for $2.5 million, the highest price paid to that time for a painting in America. It now hangs in the Dallas Museum of Fine Arts, in Texas.

CHURCH'S decision to add the broken mast to *The Icebergs* speaks, certainly, to his commercial instincts, but the addition, I think, is more complex than this; and such a judgment is both too cynical and too simple.

Try as we might, we ultimately can make very little sense at all of nature without resorting to such devices. Whether they are such bald assertions of human presence as Church's cruciform mast or the intangible, metaphorical tools of the mind—contrast, remembrance, analogy—we bring our own worlds to bear in foreign landscapes in order to clarify them for ourselves. It is hard to imagine that we could do otherwise. The risk we take is of finding our final authority in the metaphors rather than in the land. To inquire into the intricacies of a distant landscape, then, is to provoke thoughts about one's own interior landscape, and the familiar landscapes of memory. The land urges us to come around to an understanding of ourselves.

A comparison with cathedrals has come to many Western minds in searching for a metaphor for icebergs, and I think the reasons for it are deeper than the obvious appropriateness of line and scale. It has to do with our passion for light.

Cathedral architecture signaled a quantum leap forward in European civilization. The gothic cathedral churches, with their broad bays of sunshine, flying buttresses that let windows rise where once there had been stone in the walls, and harmonious interiors—this "architecture of light" was a monument to a newly created theology. "God is light," writes a French cultural historian of the era, Georges Duby, and "every creature stems from that initial, uncreated, creative light." Robert Grosseteste, the twelfth-century founder of Oxford University, wrote that "physical light is the best, the most delectable, the most beautiful of all the bodies that exist."

Intellectually, the eleventh and twelfth centuries were an age of careful dialectics, a working out of relationships that eventually became so refined they could be expressed in the mathematics of cathedrals. Not only was God light but the *relationship* between God and man was light. The cathedrals, by the very way they snared the sun's energy, were an expression of God and of the human connection with God as well. The aesthetics of this age, writes Duby, was "based on light, logic, lucidity, and yearning for a God in a human form." Both the scholastic monks in their exegetical disquisitions and the illiterate people who built these churches, who sent these structures soaring into the sky—157 feet at Beauvais before it fell over on them—both, writes Duby, were "people trying to rise above their poverty through dreams of light."

It was an age of mystics. When Heinrich Suso, a Dominican monk, prayed at night in church, "it often seemed as if he were floating on air or sailing between time and eternity, on the deep tide of the unsoundable marvels of God." And it was an age of visionaries who spoke of the New Jerusalem of the Apocalypse, where there would be no darkness.

The erection of these monuments to spiritual awareness signaled a revival of cities, without which these edifices could not have survived. (The money to build them came largely from an emerging class of merchants and tradesmen, not royalty.) In time, however, the cathedrals became more and more esoteric, so heavily intellectualized an enterprise that, today, the raw, spiritual desire that was their original impetus seems lost. To the modern visitor, familiar with an architecture more facile and clever with light, the cathedrals now seem dark. Their stone has been eaten away by the acids and corrosives of industrial air. The age of mystics that bore them gave way rather too quickly to an age of rational intellects, of vast, baroque theological abstraction.

A final, ironic point: the mathematics that made the building of the cathedrals possible was carefully preserved by Arabs and Moors, by so-called infidels.

By the thirteenth century, Europe was starting to feel the vastness of Asia, the authority of other cultures. "The dissemination of knowledge," writes Duby, "and the strides made in the cultural sphere had opened [European] eyes and forced them to face facts: the world was infinitely larger, more various, and less docile than it had seemed to their forefathers; it was full of men who had not received the word of God, who refused to hear it, and who would not be easily conquered by arms. In Europe the days of holy war were over. The days of the explorers, traders, and missionaries had begun. After all, why persist in struggling against all those infidels, those expert warriors, when it was more advantageous to negotiate and attempt to insinuate oneself in those invincible kingdoms by business transactions and peaceful preaching?"

This was the philosophy that carried the Portuguese to India, the Spaniards to Peru, and the French and British into the hinterlands of northern North America. Hundreds of years later, a refinement on this philosophy of acquisition propelled Americans, Canadians, and Russians into the Arctic.

The conventional wisdom of our rime is that European man has advanced by enormous strides since the age of cathedrals. He has landed on the moon. He has cured smallpox. He has harnessed the power in the atom. Another argument, however, might be made in the opposite direction, that all European man has accomplished in 900 years is a more complicated manipulation of materials, a more astounding display of his grasp of the physical principles of matter. That we are dazzled by mere styles of expression. That ours is not an age of mystics but of singular adepts, of performers. That the erection of the cathedrals was the last wild stride European man made before falling back into the confînes of his intellect.

Of the sciences today, quantum physics alone seems to have found its way back to an equitable relationship with metaphors, those fundamental tools of the imagination. The other sciences are occasionally so bound by rational analysis, or so wary of metaphor, that they recognize and denounce anthropomorphism as a kind of intellectual cancer, instead of employing it as a tool of comparative inquiry, which is perhaps the only way the mind works, that parallelism we finally call narrative.

There is a word from the time of the cathedrals: agape, an expression of intense spiritual affinity with the mystery that is "to be sharing life with other life." Agape is love, and it can mean "the love of another for the sake of God." More broadly and essentially it is a humble, impassioned embrace of something outside the self, in the name of that which we refer to as *God,* but which also includes the self and *is* God. We are clearly indebted as a species to the play of our intelligence; we trust our future to it; but we do not know whether intelligence is reason or whether intelligence is this desire to embrace and be embraced in the pattern that both theologians and physicists call God. Whether intelligence, in other words, is love.

ONE day, sitting in my accustomed spot on the cargo deck of the *Soodoc,* I turned to see the second engineer, who had brought two cups of coffee. He was from Guyana. We talked about Guyana, and about the icebergs, some forty or fifty of which were then around us. He raised his chin to indicate and said, "How would you like to live up there? A fellow could camp up there, sail all the way to Newfoundland. Get off at Saint John's. How about it?" He laughed.

We laughed together. We searched the horizon for mirages with the binoculars, but we were not successful. When his break was over, the engineer went back below decks. I hung over the bow, staring into the bow wave at the extraordinary fluidity of that geometry on the calm waters of Melville Bay. I looked up at the icebergs. They so embodied the land. Austere. Implacable. Harsh but not antagonistic. Creatures of pale light. Once, camped in the Anaktiktoak Valley of the central Brooks Range in Alaska, a friend had said, gazing off across that broad glacial valley of soft greens and straw browns, with sunlight lambent on Tulugak Lake and the Anaktuvuk River in the distance, that it was so beautiful it made you cry.

I looked out at the icebergs. They were so beautiful they also made you afraid.