

Cold Science

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In February, 2005, I went to Churchill, Manitoba, in northern Canada, as a volunteer on an Earthwatch¹ expedition to measure all sorts of things about the snow in several places there: on the open tundra, in swampy (frozen) fens, in forests, healthy and burned, etc. Churchill provides an ideal variety of such terrain, as the town (about 1000 in population) is right on the border between forest and tundra. To the south is “the Land of Little Sticks”. To the north and west, “the Barrens”.



The Land of Little Sticks

Scientifically, the goal was to collect data about present conditions with an eye on changes from current and coming global warming. Personally, the goal was to see if I could live and work

in such conditions: cold, wind, blizzards. Fortunately we would be living in a heated building, not in tents. What follows are excerpts from my diary during the trip.

The last three days

I'm beginning with the end because it was an unpleasant time and I want to get it out of the way and forget it, not let it spoil the rest of trip. The second morning on the train, I got up, dressed, and went into the dining car for breakfast when the lights suddenly died, came back, died again, several times over. We barely crept onto a siding near a station (we were already far south of Churchill, surrounded by absolutely flat farms, not northern wilderness), about three hours from Winnipeg (and my plane that afternoon). The locomotive was dead, and two hours later they found a bus for us, may that travel in good health.

It did and we arrived at the airport in plenty of time for my plane. But I jinxed myself saying goodbye to the others by saying "All's well that ends well." Because of snow storms (it was never clear where), all flights east and southeast were cancelled; maybe tomorrow, so I stayed overnight in some hotel near the airport (and also near where they test jet engines at four in the morning). The next day was no better: I did get as far as Montreal but no further. Another anonymous hotel, and a mess with immigration: I had gone through U.S. customs in Montreal, then back into Canada for the night and back into the "U.S." the next morning. A good thing I had a lot of books to read, but my clothes were getting old.

In short, it took three days to get home, instead of maybe five hours. Airplane travel sucks. Phooey!

There! I feel much better.

Saturday – the night before

The shuttle to the airport comes (very) early tomorrow morning. Everything's packed, one duffel bag and a rucksack with books, some warm clothes, toiletries, etc. I spoke with the kids and discussed important issues with Becca². Now for a night with little sleep – it's unavoidable. My head is filled with "What did I forget? Will those pants be warm enough? How cold will it be?" And the dangerous question, "What have I gotten myself into? It'll be hard, cold, uncomfortable, or worse." But I know by now not to listen to that question. And so to bed, whether to sleep or not.

Sunday-Monday -- Traveling

Took off in the morning for Winnipeg – it actually went smoothly, so I'll shut up about of plane travel. Approaching Winnipeg all one sees are white squares, snow-covered farms. In town I had the usual strange feeling that since I was in a foreign land, the locals would be speaking some strange language (well, in Montreal that's pretty much the case).

Taxi to the train station, left my bag, and had lunch in the nearby mall, "The Forks"; wandered around a while but it was a gray day, not very cold but a lot of splashing through icy puddles, so back to the station, to read and wait.

Ten o'clock in bed, made from the seats in the sleeping car. Very comfortable, there's even a roomy shower. I really like the clickety-clack of the wheels on the tracks, and how the car rocks³ like a boat on the ocean (but safer and not wet).

Slept well and up early, ate breakfast while the train crew turned the beds back into seats. Sunny, near the northern edge of farm country. Only about a half dozen people on the train going to Churchill; others come and go between stations along the way. I sat myself down at one of the extra tables in the dining car with a couple of books and notebook and stared out the window. In a

small wood I saw a small cow-moose and in a field further on two very small deer. In another field we noticed a lot of small, rough shacks, or so we guessed, along with a lot of other silly guesses, until we asked the conductor: they were beehives boxed in to protect them from the cold.

The rails go through forests of white or black spruce, with the occasional stand of birch, or delicate larch. Everywhere along the right-of-way were animal tracks, big ones from moose and a lot of smaller ones leading from one bush to another: ptarmigan, eating seeds and berries. Now and then a couple of miles of burned forest, thin black trunks with small green saplings pushing up through the snow. Three or four huge ravens soaring over the trees, diving at each other. Every thirty yards or so the entire way were tripods that used to carry telephone wires – no more wires, now satellites do it better. A lot of the tripods were falling over or sinking ever deeper in the swampy permafrost.

At the couple of stations where the train stopped for a while I got out to stretch my legs. Maybe 5° F. Not bad but nothing like it will be...

Tuesday – Arrival in Churchill⁴

Who would have believed it? The train arrived in town right on time. A little cold (-15° F.), with a biting wind, particularly nasty, as I went the couple of blocks from the station to the hotel.

Dressed in more clothes, I wandered around for an hour . Black ravens stand out sharply against the bright white snow. Poked around in a store with clothing, carvings, drawings, whatever one might want, though a bit kitschy. I have to buy a few presents but that can wait until the last few days, before the trip home. The museum, which is supposed to be a good one, doesn't open until afternoon; I'll leave that for the end of the trip too. My head is thoroughly occupied with tomorrow and "What have I gotten myself into?", so back to the hotel for lunch, then read a while and

took a nap. Had dinner (caribou steak) in the Gypsy Bakery and Restaurant – very pleasant and close to the hotel. At 10:30 tomorrow morning someone from the Center will pick me up. May it all go well.

Wednesday – At the Research Center⁵

Had breakfast and read a while. Promptly at 10:30 Heather, my ride, arrived, but first a few errands, coffee in the Gypsy, bought some beer and such, and finally off for the Center, about six miles east of town. En route to the airport to pick up Felix, another volunteer. The road went along the shore of Hudson Bay, immense, flat, frozen, and covered with sparkling bright snow, hard packed by the wind, with hummocks everywhere from broken and re-frozen ice floes.

Several more volunteers are coming on the evening flight and until we get together later in the evening everything is pretty loose. The Center took over the administration building from what had been a meteorological rocket range, with a kitchen and dining room, library and reading room, labs (including a cold-room), classrooms, and a dormitory. Connecting the dormitory and the other areas is the so-called “Arctic Hallway,” unheated; going from bed to breakfast does indeed wake one up completely.

At three o’clock, I went with Pete, the Principal Investigator, on a test-walk for about an hour around the ruins of the former rocket range. I’m not sure, but I think the clothes I brought will do, and I won’t have to rent more from the store in town. Away from the buildings, open to the wind, the walking is easy on the hard packed snow, but where there’s any shelter at all from the wind (usually from small groups of stunted spruce), the snow is deeper and softer, and the going more difficult. It’s a good thing I can see well enough without glasses, because with the balaclava covering my face, my glasses or goggles get immediately covered with fog and then ice.



Hudson Bay

All the “slave labor” (i.e., volunteers) arrived in time for dinner, after which we got together for introductions (and I made an effort to remember all the names⁶). Tomorrow there’ll be the “what and where and how” lecture and in the afternoon some actual work. Fine with me, not being one to jump immediately into deep water.

And so to bed. And a bit of drama. The dormitory rooms, of course, have bunk beds and my roommate, Edwin, had coughed his head off the whole evening (“Nothing contagious” he assured everyone). On top of that, he now announced that he snored, “but I brought a machine that fixes that.” He had a machine and I had serious misgivings. I lay down and listened to the machine, which hummed rather loudly, and instead of snoring there was a wheeze with every breath. And coughing. And wheezing. I lasted barely ten minutes before I bolted for another room. He’ll have to

understand, not be insulted. Fortunately there are a lot of empty rooms in the winter; tomorrow I'll move.

Thursday – Class and the Borrow Pit⁷

With Jen's permission I moved all my stuff into another room; no windows but also no tumult (and no roommates). Whew!

After breakfast we all gathered in the large classroom, to learn what we were to do. So many details. "Teacher, may I be excused? My brain is full." I hope that together with my partners (two or three will work together in a group, four groups in all) we'll remember everything, or something. I'll start off working with Felix, which looks to be a good thing. After lunch we'll do some real work!

I dressed up⁸ – it took about 25 minutes, maybe with practice it'll be faster. Outer layers were best left for dressing in the cold lab; otherwise one got all sweaty and then cold once outside.

At one o'clock outside by the snowmobiles and komatiks with the tanks⁹. Cold indeed! -20°F^{10} . -44° with wind-chill. All the gear was already lashed down in the toboggan tied on behind Pete's komatik. The "bosses" drive the snowmobiles and us "workers" ride in the tanks. Facing backwards makes the cold from the wind bearable, but even going slowly one could lose a kidney from the bumpy ride. The front of the komatik slams down at every bump in the road.

After twenty minutes of this roller-coaster ride we came to the borrow pit. Completely covered in so much clothing, and especially with faces covered, one had to ask continually, "Who are you?" until the coats became familiar.

In such temperatures the snow is very dry, like sand or sugar. Absolutely impossible to make a snowball. It sparkles in the sun

and squeaks and squeals as one walks on it, even gives out a low boom where it's hollow below the packed surface.



Komatik and Coats with People Inside

Finally, time to work. Each group is supposed to dig and measure two snow-pits. Felix and I took turns with measuring, recording, etc. at our two pits. The snow is hard packed but only about 16" deep. With four thermometers we measure the temperature every two inches from the ground up to the snow surface and also the air temperature. One also has to decide how many distinguishable layers there are in the wall of the snow-pit and what sort of crystals are in each layer, how hard and how dense each layer is. In addition, we used a "penetrometer", a pointed metal rod with weights that one drops from measured heights on the rod, to determine how much energy is required to move the rod from the surface through the snow to the ground. And finally, the corer, a plastic cylinder with metal teeth at one

end, with which we took snow samples, cylinders of snow from surface to ground; eleven samples were weighed and snow density measured; five of them we put into plastic bags and brought back with us to be melted and various aspects of the water measured.

At first it seemed that a lot of the work was rather subjective, especially (for me) deciding what was a separate layer and what sort of crystals each contained. I asked Pete, who admitted that it took some practice and the borrow pit data wasn't very important and it was a good place to get some practice.

After the first pit my left foot felt cold and a bit odd: not frozen but "dull". In that foot the circulation isn't all that good. I walked and ran around a while to warm up, which helped some. I was in fact pleased that I hadn't immediately turned into a pillar of ice.

We finished all the pits but our snowmobile refused to go. Pete, Cory, Felix, and I waited for the others to come back for us. While waiting we saw a flock of ptarmigan, maybe a dozen, like white basketballs in the bushes (that is, *they* saw the birds; my glasses were completely iced up).

Back at the Center I took a look at my foot: the toes and heel were white and odd-feeling, but still soft, not frozen. From the staff I then learned about the packets of "chemical heat" that they stuck in their boots over the toes and I bought a bunch; we'll see if they help.

In the evening we had to calibrate the thermometers and enter the day's data into Pete's computer.

Tomorrow it's supposed to blow a blizzard but there's a chance we can sneak in a morning's work at the nearby open tundra site. Oy! Now that I've lived through today, can't I go home? Well, to each day its own frightfulness.



Ptarmigan

Friday – The blizzard

No one's going outside today (except the three people working on another project studying atmospheric and weather condition; if one must, ...). -21°, only a bit colder than yesterday, but with a wind blowing 25-40 miles an hour; no new snow: the old stuff is drifting in the wind close to the ground; very pretty (looking at it from inside, to be sure).

For me, it's just as well we're not rushing from breakfast to put on all the clothing, as today Felix and I are on KP duty. The cook and his helpers prepare the meals, but we simple folk take turns in pairs doing the dishes and cleaning the tables.

But it's not a day off, but an opportunity to deal with the snow samples (now melted) from yesterday. One has to pour the water through filters to determine the weight of whatever was in the

snow, and to measure the pH and electrical conductivity of the water itself. I have to say that sometimes science can be a bit tedious. But we formed a sort of assembly line and it went quickly.

I also helped prepare specimens of local plants for the Center's herbarium. And a bit of reading and writing. I bought t-shirts in the gift shop, one for me and one for Becca.

After dinner Pete gave a talk about arctic geomorphology, the different forms of terrain found in areas with permafrost: peat- or frost-polygons, pingos, muskeg swamps, etc. Very interesting. And afterward, to bed. Tomorrow we're going to work at an example of the so-called peat-polygons¹¹ where the permafrost is aggrading.

Saturday – The Aggrading Peat-Polygons and the Tundra

Off to the peat-polygons in the morning. Not a long ride, thank goodness. A thin patch of trees provided some shelter from the wind but still a cold day: -23° , or -51° with the 15 mile an hour wind. With the hot-packs in my boots, my feet were fine. In the peat-polygons the centers were higher than the edges, which were shallow troughs over buried ice-wedges¹². Two snow-pits from the centers and one from an edge. This was the first time I've peed outside in such cold, managed without freezing anything.

After lunch at the Center, off to the tundra site, only about ten minutes in the tanks. A bit warmer: -17° . Completely open to the wind, the snow is packed hard and only about eight inches deep. The work went smoothly and fast, soon done, and I walked around looking at the lovely shapes carved in the snow by the wind. Frozen waves, called sastrugi, covered the whole surface. I had read of them and seen pictures from the Antarctic, but never before with my own eyes. Very pretty to look at but hard to walk on.

In the evening I sharpened the teeth on the four corers; tomorrow we'll be working in a place with hard ice-layers in the

snow, according to Anna, another researcher working at the Center.

In the dining room after work, I sat and chatted with some others about politics; everyone (except Edwin) agreed that Bush is a weed.



Sastrugi

Sunday – The Fen and the Degrading Peat-Polygon

First stop, the fen – good thing it’s all frozen. Summertime this would be a sopping wet bit of tundra, now 15” of snow. It’s -20° but only a slight breeze. Pete is sleeping in with the cold that’s “going around.”

After lunch at the Center, off to the degrading peat-polygons. Not that they’re anything as bad as that sounds, but unlike yesterday’s peat-polygons, these are losing some of the permafrost and the ice-wedges in the edges have melted and the polygon

edges have become deep troughs filled with snow, about two feet deep. In the two center pits, there's only a couple of inches. Felix, Ruth, and I walked back to the Center after finishing, maybe three-quarters of a mile.

But my feet were pretty cold again, like the first day. Back in my dorm room I took a look at the used heat packets: pretty bad, three years past the printed drop-dead date. The same with most of the remaining ones. I spoke with LeeAnn and got new ones.

Don, the cook, made a stew from musk ox meat: tasty but (to me anyway) not very different from beef stew. Also arctic char, also tasty. We all chipped in to pay for the special dinner.

Even with the light from moon, almost full, tonight there was a lovely aurora, pale green and white, waving to and fro across the whole sky. Orion also bright in the sky. We watched warm and comfortable from the dome on the Center roof.

Tomorrow is a day off. Some want to build a snow-igloo¹³ and sleep in it. After lunch most of the group is going into Churchill, to the museum and other tourist stuff. I'll probably stay here and take it easy; I'll be in town a day and a half at the end, before the train heads south on Saturday.

Monday – Day off

After breakfast a competition began between some of the volunteers (not me – I watched and kibitzed from time to time) and the Center staff: who can finish a snow-igloo first. Near the Center there was an area with the right sort of hard-packed snow. Usually, two Inuit could complete an igloo in a couple of hours; after three hours, these two were maybe half finished, two and a half turns of the spiral.

And for now that will have to do, since they're going into town for the afternoon. I worked a while filtering water samples in the lab and then sat in the library, reading and writing.



Aurora

Pete is feeling better but now Kristin has taken her turn with the communal cold, may it go no further! Lis leaves this evening after working hard for the week.

Tonight “at the movies” – a video of the third Harry Potter movie. Holds up well on repeat viewing.

A new challenge for tomorrow, woe is me: a long ride in the komatiks, about four miles, 45 minutes. Too far to have lunch at the Center, so we’ll stay out the whole day. And deep snow in the trees.

Tuesday – Twin Lakes

Breakfast and then we made sandwiches, thermoses of coffee and cocoa, and finally into “uniform”. We stopped somewhere in the middle of the long ride to stretch our legs and to watch some ptarmigan in the bushes. There was a clear network of their trails

connecting all the bushes. A lovely day, bright and sunny; maybe I will live through this.



The Author in Uniform

Of course, there was no sign of the lakes except broad flat areas of ice, covered with some snow or completely bare, on which the snowmobiles and komatiks made an awful clatter. First stop, the black spruce bog; -11° , with an eight mile an hour breeze, too warm for the face mask. It was a pleasure to be able to wear my glasses and to see.

Very deep snow, thigh-high in the deeper drifts! About 32" more or less in

the two snow-pits. After the morning's measuring, we cut some dead branches and Jennie made a bonfire, after digging out a hole for it so it wouldn't melt its way into the snow and put itself out. Quite comfortable, sitting on a few fallen trees, eating, with the smell of wood smoke in the air. My thermos seems to have a crack somewhere and held only "chocolate slush" but there were others.

After a short ride, we worked at the burnt spruce forest. A stark but pretty scene, row upon row of thin blackened tree trunks against the sparkling white snow. Still warmer: -4° . When we



The Burned Forest

were done, Felix and I wandered around, though it was hard going in the deep snow.

Well, a whole day outdoors – not bad! And no trouble with cold feet. A good thing it was a warm day. As they say, “It could have been worse.”

The Center staff is an interesting bunch. LeeAnn worked before on scientific expeditions to Ellesmere Island and other places in the far north. The two cook’s helpers, Anna and Jane, are sisters from Australia who’ve been wandering around the world doing this and that. I would be jealous except I’ve never even come close to being so foot-loose.

Tomorrow to the so-called “tree island” – even deeper snow than today.

Wednesday – The Tree Island

In the middle of the wide open tundra was a small copse, a dozen spruce, which had trapped every bit of snow that blew by. Deep indeed. Instead of the usual four groups and two pits each, we'll do three pits in the morning and two more later. Felix, who is a glutton for punishment, volunteered us for the deepest pit, which turned out to be more than nine feet deep. But then he did take the shovel and ignored my every offer of help. Ok by me. Afterward I did get to dig two large steps so he could get out of the pit and we could do the measurements (to take the 56 temperatures the four thermometers had to play leapfrog up the pit wall).

Really a lovely day – -8° and sunny, but with a bit of wind. I took off my face-mask and put on sunglasses. A half hour later Felix told me my nose had gone white. I warmed it up with a hand and covered my face with my scarf. In the evening I noticed a small blister between my nostrils – a very small bit of actual frostbite – probably from some ice from condensed breath on the scarf.

The penetrometer and corer were half as long as the snow was deep, how does this work? Six or eight inches back from the wall of the pit one did the thing, until the ram or corer was down to the snow surface, then shoveled away the snow from the pit wall to the instrument so one could continue downward. And we'd brought large garbage bags to hold these samples.

Felix and I walked back the mile or so to the Center. After lunch I stayed inside and worked in the lab, while a small group went back to the tree island for the last two pits. Which didn't take long, so they went back to work on the igloos. The volunteers finished theirs, though it was a bit lopsided. Tomorrow Felix, Ruth, and Kate will sleep in it.

In the evening Pete gave talk about global warming. There's no doubt that the world has warmed up $1-2^{\circ}$ C. or more, recently and

quickly. And while the earth has certainly gone through many cycles of hot and cold since it invented weather, never so quickly. Also no doubt that the prime cause of this is human activity, leaving the difficult political matter of what to do about it. Edwin doesn't believe any of this.



Deep Snow in the Trees

Tomorrow is the last work day, Friday everyone but me flies off and Saturday night my train leaves. I offered to stay until Friday evening (when I had a hotel reservation in town), to finish up more of the lab work. Even better: Jen said I could stay over Friday night if I wanted (paying for meals, of course). Fine with me, not to be an “orphan” in town, so I cancelled the hotel.

Thursday – White Spruce Upland and the Replanted Forest

I survived! Not that it was easy, but it did get easier with time.

Another long chilly ride to Twin Lakes, -29° in the morning, -49° with the 15 mile an hour wind.



Frozen Lake

First stop is the white spruce upland, with deep snow in the woods, over the knees. I took one of the four pairs of snowshoes and helped stamp out a path from the sleds to the pit sites. A bit warmer, -20° , and the wind died down; it didn't seem particularly cold. Maybe one gets used to the cold (of course, only now, at the end of the trip). A weak sun shone feebly through thin clouds, with bits of pale blue sky here and there. The pits were about two feet deep and the lower layers of snow were loose and fluffy – several times, when one stuck a thermometer into the pit wall, the snow crumbled and the thermometer fell out.

We had lunch nearby, no bonfire, but plenty of fallen trees for seats. In with all the spruce were a sprinkling of larches (which

lose their leaves in the fall, although they have cones like other conifers).

A short ride to the replanted forest, that is, a burnt forest deliberately replanted without waiting for nature to do it. Cold left foot again, but maybe a half hour after lunch I felt quite warm again, the foot as well, when lunch “kicked in” – probably would be a good idea to nibble a bit steadily throughout the day. The pits were about 30” deep; temperature -23°.

On the way back to the Center we took a small detour to visit the instrument tower of the other project and chat a while with the researchers working there. It’s funny to listen to a couple of experts talking shop, especially when they’re equipment freaks.

And finished! With the days off for blizzard and igloo building, we still worked all the sites. Hallelujah! All the troubles and worries gone, forgotten, just like that, a silly human trait (without it, Cain would have been an only child).

In the evening two guys arrived with a couple of dozen crates of equipment, for whatever they’re to do; I’ll ask. After dinner we filtered for a while, helped by a little whiskey and an assortment of caribou, musk-ox, and char jerky.

Tomorrow the gang departs. Tonight Felix, Ruth, and Kate are in the igloo. I’m not at all jealous: I slept out one night in a tent in Maine, at -29°; interesting, shall we say, but that’s another story.

Friday – Their Departure

It’s suddenly so still! Before the other volunteers went to the airport, we dithered about outside in front of the building so all the digital cameras could take a group picture. Then goodbyes and they were off. It was a good group and a pleasure working with Felix – lucky that we started together and the mentioned “musical partners” never materialized (the other groups did mix up more as someone stayed in of a day).

The two newcomers are from the Canadian Wildlife Service. They'll be here for a month, studying the female polar bears and cubs that are just starting to come out of their dens in the tundra east and south of the Center. A lot of equipment, including a rifle shooting sedative darts instead of bullets (or both?).

I filtered the samples from four pits. Bought an A-B-C and a 1-2-3 book for Becca and paid my bill. Sat for a while in the library.



A Rugged but Beautiful Land

At 3:30 I went for a walk with Pete, who had to download the data from a recorder that lives about a mile out in the tundra. Warm, -11° , with a low sun nearing the horizon. It's beautiful, this land, if harsh. It has a strength towards which one mustn't get careless, can't say "Wait a sec, Wind! Excuse me from the cold! Lemme find the mitten that just blew away."

It's amazing to me how the arctic explorers of old, John Rae, Samuel Hearne, walked all over the Canadian arctic, tens of miles a day, months long, years, in all weathers, all seasons, sleeping rough or in tents, with warm hands and feet!

Saturday-Sunday – Going Home

In the morning I filtered the few prepared water samples and then – no more scientist! At two or three in the afternoon, a bunch of Center staff are driving into town and they'll take me along to the train station. Meanwhile Pete and the two bear guys went off in a helicopter, looking for bear; I helped them load up, said goodbye to Pete, and made myself comfortable with a few books in the lounge in the dorm. Across the road a half dozen ptarmigan were foraging in the trees and bushes.

In the van going into town they indulged in a bit of gossip, which was a relief to me, to see that I wasn't the only one who thought that... I left my duffel bag in the van; they'll bring it to the train station at 7:30.

The Eskimo Museum was very pretty – nicely laid out artifacts, carvings, drawings, tools. I bought a wool hat, a book for a present, and a lovely postcard of an inuksuk, a stone cairn shaped like a person, against a gorgeous sunset. The few other art galleries in town were closed, so I went into a bar, completely out of character (though I say so myself), and had two beers and a friendly chat with the bartender and another drinker. Then back outside, a bit tipsy, admiring the half dozen ravens, huge ones, flying around and hopping along the street, croaking. Almost sunset, around five, with the sun shining weakly over the river through a thin cover of clouds. Ate too much at the Gypsy and went to the train station to wait. At 8:15 (arctic time, one must keep in mind), the crew from the Center came by with my duffel bag and after warm good-byes, I boarded the train.

Along with about forty excited kids, maybe 10-14 years old, and a few parents as chaperones: two hockey teams from Gillam and Thompson, towns about 185 and 340 miles from Churchill. They were returning home after a hockey tournament in Churchill. They hadn't won, but had had a good time, boisterous but polite. They'll be home in the morning. Let them celebrate – it's quiet here, two cars back. The sleeping car is in fact quite full; I'll have to sleep with all my stuff in the berth (not the duffel bag, thank goodness, which I had put in the baggage car).

A homey commotion in the lounge part of the dining car: two sets of parents of hockey players chatting at one table, a woman from Churchill going to Winnipeg for a vacation, two older Inuit women playing cards, kids running in and out, and an American couple, tourists, a bit condescending. Read and eavesdropped a while and then to sleep in my "tent".

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Slept well, back to the comfortable clickety-clack and the rocking.

The dining car was packed for breakfast with a lot of the hockey players and some parents. It's interesting to see kids who've grown up here take the cold quite for granted without getting careless. No one runs outside casually without getting properly bundled up. The Gillam team got off early in the morning; the Thompson team about eleven.

A bit odd looking: by every switch in the tracks there's a broom stuck handle-down in the snow, in case one needs to brush the snow out from the points when the train has to switch to a siding. And twice in an hour I saw one of the engineers standing by the rails checking the wheels for hot bearings with an infra-red detector, first on one side as the train moved slowly forward, then on the other side going backward until he boarded the engine again. "Why so often?" we wondered, until someone noticed that

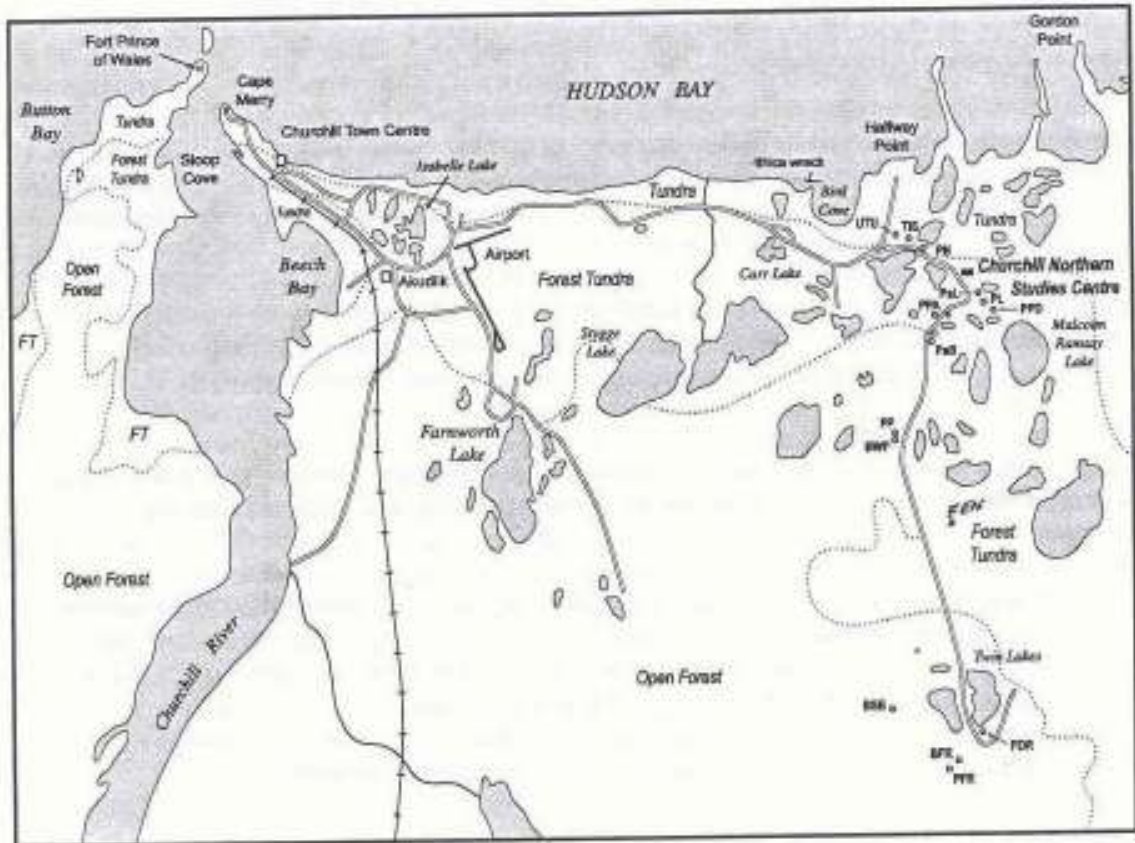
he was taking advantage of the “chore” to have a cigarette, smoking being forbidden on the train, even in the engine.

Sunny, with fresh snow covering most of the animal tracks along the way. A lot of birches among the spruce. A pale moon, just past full. We crossed the Nelson River, wide, with some open water on both sides of the railroad bridge, shining white in the distance, frozen and covered with snow. Someone came from up forward and said that there'd been a wolf on the tracks ahead. I'm sorry I missed that. Passed through a couple of very small towns and the large burnt forest, with a lot of new trees pushing up through the snow.

A couple from Ontario; the husband builds model railroads as a hobby. The Churchill woman runs a bed-and-breakfast, has lived there twenty years or so. And the American tourist couple are traveling all over the U.S. and Canada by train; she's quite nice but he's a bit pretentious, knows everything; well, maybe he does.

The low sun shone through the old glass insulators on the old telephone poles, making them light up like lanterns – odd but very pretty.

After dinner, I read a while and wrote some. Then into bed. Tomorrow we arrive in Winnipeg and I fly home.



Map

BWP: Borrow Pit

UTU: Tundra

PPD: Peat-polygons degrading

BFR: Burnt spruce forest

FOR: White Spruce forest

PPA: Peat-polygons aggrading

FEN: Fen

BSB: Black Spruce bog

TIS: Tree Island

PFR: Replanted burnt forest

¹ Earthwatch is a private organization based in Massachusetts that supports scientific projects all over the world, both financially and with volunteers, “slave labor”, that is, educational, working vacations. Take a look at their web page: <http://www.earthwatch.org>.

² My granddaughter, 18 months old.

³ This particular train rocks more than most others. The northern half lies on permafrost, frozen earth, rocks, ice, and peat. In the summer only the topmost foot or so melts, making a vast swamp; lower down it remains frozen all year round (that’s the case now, not to speak of what changes global warming will bring). Such terrain is called “muskeg” and this railroad’s nickname is “The Muskeg Express” (never mind that it only occasionally hits 40 miles an hour). It’s very hard to lay down rails and keep them level and smooth on such terrain.

⁴ During WWII Churchill was bigger and busier: it’s close to England and Europe on the great circle route and a lot of grain was transported from the plains of central Canada to England, even though Hudson Bay remains frozen nine or more months in the year. Grain still comes into town and goes on by boat and there are large grain elevators at the edge of town, between the Bay and the Churchill River, but much less than previously. Now the town deals in tourists, bird-watchers and, even more, polar bear watchers, for the bears that come into and around the town in the Fall.

⁵ Churchill Northern Research Center provides Earthwatch expeditions and other research projects with a base for working in the area. They also have “educational vacations” for bird-watchers, bear- and northern lights-watchers, winter survival training, etc. See <http://www.churchillmb.net/~cnsc>.

⁶ The personnel (excuse the gossip):

- Pete: Principal Investigator, from the University of Alberta. A pleasure to work for.
- Eleanor: one of his graduate students, studying how the treeline extends further north into the tundra (strange to say, she really felt the cold).
- Jennie: also one of Pete’s graduate students, studying “gardening on gravel”, i.e., how tree seedlings and other plants colonize stony ground.
- Jen and LeeAnn: on the staff of the Center, they helped with our work and with other projects.
- Heather: also on the Center staff. Helped with logistics and whatever needed doing.
- Don: Cook, and a good one – no one went hungry.
- Anna and Jane: from Australia, sisters. Cook’s assistants. Also came with us to help on their days off.
- Lis: from Massachusetts. Works for Earthwatch and wanted to see for herself what such an expedition is like.
- Edwin: from Tennessee. A retired optical engineer. ~~Privately I gave him a nickname, “Tits on a Bull” and with that, I’ll shut up. To give credit where due, he did what he could without complaints.~~
- Kristin: from California. A computer programmer. For a few days she came down with something and had to stay in, doing a lot of the lab work.
- Kate: from Australia, but living in London.
- Barry: from Massachusetts. That’s me, a burned-out computer programmer.
- Ruth: from Vermont. A high-school student. Very bright and capable, one took her for much older.
- Felix: from Germany. A business consultant. A pleasure to work with.
- Cory: from Massachusetts. Teaches high-school physics.

In age, Ruth was the youngest, a teenager; Edwin and I were the oldest, in our sixties; the others somewhere in between.

⁷ A digging or quarry for gravel and stones used to build the few roads and such in the area.

⁸ What did I wear?

- Feet: thin socks, thick wool socks, insulated boots. I quickly learned about the wonders of the chemical heating packets that one stuck into boots (over the toes, between the socks) to help keep feet warm.
- Below: underpants, long underwear bottoms, thick woolen pants, wind-pants, high gaiters.
- Above: long underwear top, thicker long underwear top, wool shirt, a thick fleece, and finally an anorak (a bit of a squeeze).
- Head: balaclava or face-mask with a wool hat, anorak hood, a scarf around neck; sunglasses or goggles, but they were usually fogged up and icy, at best translucent.

- Hands: thin gloves, thick wool mittens, overmitts.

In the later part of the trip, when the days were somewhat warmer, I wore the same outfit, but loosened or removed a layer or two. It's important to avoid sweating.

⁹ "komatik" – the Inuktitut (the Inuit language, dialects of which cover the Arctic from Alaska to Greenland) word for sled. Made from wood with the boards bound together with straps, no screws or nails, so the sled itself can flex and bend and not break bouncing on the first bit of unevenness en route. Each komatik had a tank lashed to it, a plywood box, about three feet wide and high, eight feet or so long, open on the top, for cargo, be it gear or people.

¹⁰ In Canada and in scientific work, everything should be in Celsius, centimeters, etc. but for home consumption, everything will be in "Old English" units, Fahrenheit, inches, etc.

¹¹ Polygons are formed by thousands of cycles of freezing and melting. A pingo is a small hill with a core of ice.

¹² In the similar stone-polygons or frost-polygons, the edges are raised lines of sorted-out stones and the centers are sunken, very wet in the summer.

¹³ "Igloo" in Inuktitut just means "house", not just the well-known dome made from snow-blocks. Snow-igloos were used mostly for a few days at a time or to wait out storms while hunting or traveling in winter; otherwise winter quarters were generally peat houses and in summer, tents.

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