

Runes of the North, Reprised

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It's definitely among the lesser-reported impacts of global warming, but it's undisputed. Jeanna Edlund, age six, is missing her daddy.

He's missing her, too. Being away from family is the single downside of an otherwise extraordinary experience. Mark Edlund is 1200 miles from home, in the Canadian "low Arctic," just north of the 59th parallel. He's one of a team of researchers assembled from 4 institutions, engaged in a multi-year project funded by the National Science Foundation. They are here in this remote region of Northern Manitoba to assess the responses of terrestrial and aquatic systems to climate change.

As a Senior Scientist based at the Science Museum of Minnesota's St. Croix Watershed Research Station, Dr. Edlund's specialty is diatoms. On this project, he'll use these microscopic algae to tell a story—the story of how environmental conditions have changed over time in this northern landscape since the glaciers left a scant 7500 to 8000 years ago. Diatoms are wonderfully suited for this role, since their cell walls are made of biologically produced glass that persists for millennia in lake sediments. "Diatomists" like Edlund study changes in diatom species and abundance over time for clues to past events and current trends in the larger landscape.

It's the kind of story that Mark Edlund has delighted in unraveling since he was first introduced to diatoms as an undergrad in a botany lab at the University of Minnesota, when he was thrilled (no kidding) to learn that the powder he used to filter french-fry grease at his fast-food job was actually "diatomaceous earth," a type of algae. Now, some 25 years later, his enthusiasm for their study remains irrepressible. He admits that his curiosity is sparked anew every time he slips a slide beneath the lens of a microscope, whether at work or at home in the wee hours of the morning while the rest of the household sleeps ("Okay, he grins broadly, *so I'm still a geek.*"). Slim, dark-haired, with a ready smile and the kind of quiet confidence that comes from doing what you love and knowing your stuff, Edlund makes a great case for geeks.

His growing expertise in the scientific applications of these "darn beautiful organisms" has led to research studies of aquatic systems near home and around the world: from the St. Croix and Mississippi Rivers, to the Great Lakes, to Russia's 25-million year-old Lake Baikal, to the pristine lakes of Mongolia, and now to this little-studied region of the Hudson Bay Lowlands, 150 miles from the nearest road. He is living his lifelong dreams, and he knows it. As a first-grader—the age his daughter is now—he was already declaring in crayon "I want to be a scientist."

Every place he's traveled has been uniquely compelling, and this is no exception. Looking through the windows of the small plane upon his early-July arrival in the sub-Arctic seventeen days ago, he had been struck by the enormity of the landscape and the relative lack of visible traces of human habitation. For mile upon mile, as far as he could see to the horizon in every direction, there was no road, no power line, no fisherman's cabin. Instead, there were signs left behind by two very different forces. From his aerial viewpoint, he could clearly see the deeply etched trails of the barren-ground caribou fanning across the land like the web of a manic spider: their lines criss-crossing over ridges and converging at the edges of lakes and shallow river crossings, following annual migration routes they have used for centuries. And everywhere in evidence was the handiwork of the recently departed glaciers. Lakes of all sizes filled myriad depressions in the land, many hemmed in by massive eskers rising 50 to 300 feet from the water's surface. The gently rolling tundra was strewn with the giant boulders known as glacial erratics, that had been carried far from their points of origin and dropped when the ice melted. For a relatively new landscape, geologically speaking, it somehow managed to appear ancient.

Edlund was moved at the sight. In all his travels, he'd never witnessed anything like this vast, trackless land. If not for the few jet contrails in the sky, it would be easy to believe that there was nothing else out there: just endless, endless world.

In the weeks since, he's come to know many of these lakes and landforms personally, if not intimately. Certainly, he's learned to calculate the biting insects of the Arctic summer based on the degree of wind (strong wind = deer flies + horse flies, moderate wind = the aforementioned + black flies, light wind = all the aforementioned + mosquitoes). He's also devised a system to cope with them (tolerance, more tolerance, DEET). But the pests barely register a blip on the radar for Edlund, for there are far more interesting things to think about.

It's been both a fascinating scientific inquiry and grand adventure. Along with his fellow team members (4 scientists, 3 undergrad students, a pilot), he has roller-coastered over eskers to land their old 1948 Beaver floatplane on more than forty lakes, assembled rafts of plywood and inflatable canoes to use as platforms from which to collect water samples and lakebed sediment cores, dug pits into the peat for samples of surface sediments, and hiked across the tundra and through spruce forest documenting patterns of vegetation.

Evenings have been spent back at a well-appointed fly-in hunting and fishing lodge on Little Duck Lake, where the research team is based. There is dinner, time to log the day's data on laptops, even catch up on correspondence via satellite internet. Best of all, there is opportunity to gather with his colleagues to air out hypotheses and passionately discuss their various areas of scientific inquiry to a degree of minutia they rarely (okay, never) get to enjoy in other social situations.

If Edlund is to get the sleep he needs for the next day's fieldwork, he must call the day finished long before dark. Night is a fleeting creature here in mid-summer; with the sun

barely dipping below the horizon before it is up again. At midnight, the sun has just set, and by 4 a.m. it has risen anew. He has given up trying to see the stars. Each night, he pulls the shade against the persistent light, and jots a few notes in a personal journal, then reads from Sig Olson's classic *Runes of the North*. It's a signed copy that he has inherited from his grandfather, who prior to his passing had been an avid conservationist and Isaac Walton Leaguer, very active—as Sig had been—in efforts to preserve the Boundary Waters Canoe Area Wilderness. He had brought the book along, thinking it might speak generally of life at northern latitudes, adding to his perspective on this journey. But Edlund is startled, as he reads, to come upon a passage in which Olson tells of witnessing caribou from the top of an esker less than a mile away from where he is now, and another describing the same abandoned Hudson Bay Trading Post that he himself has seen at the south end of the lake. It looked just as Sig had described it, these fifty years later. Strange, how his place seemed to have a telescoping effect on time.

At last and too soon, it is July 21st: a Monday morning and the day before their departure. Their research plane has been grounded by high winds, fortunately a rare occurrence on this trip. Edlund is “ground truthing” with fellow scientist Charles Umbanhowar. They are walking the hummocky peatlands south of the lodge, taking GPS readings to pinpoint locations, then documenting the vegetation with written notes and photographs. Later, these on-the-ground impressions will help not only this team but also future researchers to better interpret images of the region gained from remote sensing by satellite.

As he walks, Edlund considers what they've managed to accomplish in their weeks here. In general, he is pleased. The weather has been cooperative, and there have been relatively few of the technical glitches that can plague research trips. Good groundwork has been laid for the remaining two years of the study.

At this stage of the project, it's largely about raw data. They've collected thousands of samples. Interpretation and findings will have to wait for exacting analysis back in a laboratory setting, at the St. Croix Watershed Research Station and other facilities. Water samples will provide information on lake productivity through assessment of physical parameters such as nutrients and pH. Nearly 70 linear feet of lakebed sediment cores will be taken from their tubes and cut into sections, each a representative record of a discrete period of time; the distant past reflected by the deepest sediments, more recent history by the sediments nearer the surface.

Edlund is excited to think of what may be revealed through study of the cores' contents: the insights that may be teased from whatever diatoms, pollen, and charcoal they might contain, as well as from the samples' biogeochemical attributes (e.g. carbon, minerals, silica, phosphorus, nitrogen, magnetic properties). When combined with the terrestrial components of the study, he trusts that a new and far more complete picture of this region's environmental history will emerge. And with it, for better or worse, a greater understanding of the impacts of climate change, already evidenced here by a 0.4°C rise in each of the past four decades.

He leans over to pick a few wild blueberries to eat. In the hurry-up growing season of the far north, they have gone from blooming flowers to ripe berries in the few weeks that he's been here. Edlund considers the delicate threads of subsistence here. It would be a hard go, he thinks, to live off this land. This is the height of summer, and in all the miles they've covered by air, and all the time spent on foot, he has seen a single cow moose and her calf, a smattering of ducks, an Arctic hare, the tracks of a lone wolf on the esker ridge where they had lunch one day. Of course, there were fish to be had: the lodge staked its reputation on the impressive northern pike, lake trout and Arctic grayling.

And the big event of the year would come in August and September, with the passage of the Qamanirjuaq caribou herd, which reportedly numbered nearly 500,000. He would like to have seen them, but he will need to content himself with the sight of their trails and their antlers rising from the tundra like so many leafless shrubs. The caribou are "tuttu" in Inuktitut, the mother tongue of the predominant aboriginal people—the Inuit—who dwell here and in neighboring Nunavut, the vast Canadian territory that reaches from Manitoba's northern border to the Arctic Circle.

He knows so little about the lives of these people, their past and present. Like most scientists, he's quick to acknowledge the limits of his understanding. He wonders if what is learned here by the team's studies of environmental history and its relation to climate change will be of use—if the findings will offer some degree of predictability about what is to come. He hopes so.

By afternoon, the last of the work has been wrapped up. The pilot (a.k.a. "Captain Mark") is taking the first load of gear back to Thompson, Manitoba, and will be back in the evening. Edlund and Umbanhowar head out by boat to the river channel between Little Duck Lake and Lake Najanilini, aiming to wet a line and catch some fish for dinner. Just as Edlund is pulling in a 24" lake trout, a huge storm blows in. They get the fish into the boat and roar back to the dock amid rising waves, then high-tail it back to the lodge as the rain pounds down.

Hours later, Edlund ventures out again for a final walk on the esker to watch the sunset. Another storm, he sees, is rolling in. He can feel the wind kick up. But already he is partly gone from here. In his duffel, carefully packed and waiting beside his bunk back at the lodge, are the requisite "cool things" for Jeanna. There is a fish jaw, a plastic bag with some wolf scat (complete with bones!), and a small slice cut from a downed tamarack tree, barely 3" in diameter, but showing more than 200 annual rings. She's going to love them.