Walden to Wobegon

A Freshwater Journey from Maine to Montana

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Summer, 2009

Note: This is an unpublished e-book that combines twenty consecutive blog postings from a road-trip in the summer of 2009. The photo above shows the northernmost reach of the Mississippi River near Bemidji, Minnesota.

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Introduction

During the summer of 2009, my wife Kristine and I took a road trip from Maine to Montana. Our initial goal was to call attention to my latest book, *Beyond Walden: The Hidden History of America's Kettle Lakes and Ponds*, and to focus on the physical and cultural connections between New England and the Upper Midwest. Before we left, however, we had decided to broaden our focus to all freshwater resources in these northern states. So, instead of visiting independent bookstores and media outlets, we decided to survey the attitudes of ordinary people had regarding Earth's most vital substance, fresh water.

We asked the same double-edged question in the streets, parks, motels, restaurants, gas stations, museums, libraries, stores, offices, roadsides, bait shops, taverns, kiosks, and visitor centers of America. "What to you like best about fresh water? And what is your main concern? Some of the answers we got were astonishing, for example the breakfast host in Aberdeen, Dakota who didn't know what freshwater was. Most were surprising because our question was so open-ended. Most importantly, however, the answers we got were highly variable because each water sub-culture had its own issues.

Prarie pothole in central South Dakota. These wetlands were indiscriminately filled during the first half of the 20th century because straight roads were deemed the best roads.

This blog is a memoir of that trip. Written in the style of John Steinbeck's *Travels with Charley* and William Least Heat Moon's *Blue Highways*, it is anecdotal in style. We hope that you will enjoy it as a complement to the more quantitative, bland, vetted, and politically correct stuff that comes from government agencies and scientific reports. In North Turner, Maine, for example, we attended a meeting of the Bear Pond Improvement Association. There we heard the good news that the clarity of the lake was improving and the bad news that more than half of the loon deaths statewide are due to lead poisoning. Nearly three weeks later, we were in the badlands of Medora, North Dakota visiting Theodore Roosevelt National Park. There, a kayaker was reminiscing about the beautifully braided channels of the Little Missouri River before wincing about a defiant rancher who strung an electrified wire across a publicly managed stream, nearly garroting one of their party.

To such water stories, I added my own professional observations as seen through the bug-spattered windshield of our station wagon. For example, in Hackensack, Minnesota -- alleged to be the home of Paul Bunyan's domineering wife Lucette -- we saw a team of eight reindeer created from rusty home heating-oil tanks, some of which probably leaked into local aquifers before being discarded. I also added stories excerpted from local newspapers you probably never heard of. In Williston, North Dakota, the U.S. Air Force had been strafing the city with insecticide on behalf of a municipal bureaucracy called the "Vector Control," which was coping with a mosquito problem exacerbated y the U.S. Army Corps of Engineers.

Our geographic focus was the glaciated fringe of the former Laurentide Ice Sheet, which covered the northern and north-central United States (including southern Ontario) until about 15,000 years ago. Extending from the crystal clear ponds in New England to the potholes along the Lewis and Clark Trail in the High Plains, it was largely responsible for creating the lakes, watersheds and aquifers found today. This great geologic slice of America faces great uncertainty with respect to water issues. The climate is changing, the population is growing, energy development is threatening, recreational activities are shifting, kids are paying less attention, and concerns about public health are rising. What do ordinary people think? What are their experiences? Having found out, we linked them to the ever-changing physical and cultural landscapes we found ourselves traveling through.

We stuck to the back roads as much as possible, beginning with the rain-soaked, winding pavements of Maine's lake district and ending with the dry-baked, ramrod-straight gravel roads of Sheridan County, Montana. Our journey took us through the highlands of New Hampshire; the 18th century villages of Massachusetts, Rhode Island, and Connecticut; the rolling Berkshires in western Massachusetts and the Green Mountains of Vermont; the Lake Champlain Lowlands and the Adirondacks of upstate New York; the Saint Lawrence River and the northern shores of Lakes Ontario and Erie; Michigan's mitten and its and Upper Peninsula; across Wisconsin's Ice Age Trail; here and there in Minnesota; and west through the prairies of the twin Dakotas. Throughout it all, we kept our feet on the ground and where the rubber meets the road, riding the interface between earth and sky, the place where hydrology happens.

Intense traffic happened only twice: northwest of Boston near Minuteman National Park, and on "The 401" during rush hour through Toronto. On two occasions, we were completely alone: nearly stuck on a washed-out logging trail in central New Hampshire, and on Route 216 in eastern Montana where we cruised along on a midsummer Friday afternoon without seeing a single stop sign or human being for an hour.

My ultimate purpose is educational, within the realm of Environmental Studies. Clinker, couteau, coulee, aquifers, aquamarine, artesian, potholes, bentonite badlands flood, drought, anhydrous, ammonia, flocculation, fluoride, LUST, limnions, kettles, catchments, and so much more. These are the words I would have used were I designing a crossword puzzle based on the text.

Culvert art in Wibaux, Montana is part of the story. A bucking bronco of freshwater. management.

With Kristine driving, I was free to drink in the scenery and soak up what people were saying. And being an early riser, I had each morning to distill the daily results out of my head and pour then into a blog posting. When the trip was over, we high-tailed it back to Bemidji, Minnesota where I stayed put for a week while editing the results into a flowing narrative, and adding what I didn't have time for on the crushing daily schedule. The result combines the intensity and quirkiness of a daily journal with the measured pace and uniform style of an edited manuscript – a time capsule from the summer of 2009.

To generalize the results, I number the days in sequence, rather than gave them dates. For conversion purposes, Days 1 and 2 were June 29 and 30, respectively. Days 3 through 20 were July 1 through July 17.

To follow along, just use any of the standard GIS-based internet maps, looking up the place names mentioned in the text.

Day 1 – Bear Pond

We awoke in the rain. Earth's most precious substance was dripping out of the gray sky, an auspicious beginning for a road trip devoted to fresh water. Parked above us was a dense bank of low stratus clouds that hadn't thinned or moved since we arrived the previous evening.

When doing laundry, the first wash cycle is always dirtier than the final rinse, even if you forget to put I the soap. It's the same when planet Earth is washing the sky. The first few hours clean the dust, grime and other contaminants out of the local atmosphere. After that, the rain is clean enough to drink, something that kids do all over the world. On every continent, they open their mouths to the sky and let the warm rain fall in. They find that it's got a slight tang, a mild acidity imparted by carbon dioxide in the air.

We the People

"We pledge allegiance to the flag of the United States of America…"

With hands held gently over our hearts, Kristine and I recited the Pledge of Allegiance. Never have I heard it given with such an even combination of sincerity and folksiness.

James Adams, 2009 President of the Bear Pond Improvement Association

About seventy people were gathered in the Boofy Quimby Memorial Center in North

Turner, Maine. Resembling a warehouse on the outside but decorated in the style of a gymnasium, this all-purpose building was built in 1976 to honor a local boy named Lester Quimby, Jr. who died when he was only eleven years old, the perfect age to pass a Maine winter by playing basketball, and the summer by swimming, fishing, and boating at Bear Pond. I remember being Lester's age, the chapter in my life coming after the limitations of childhood, but before the awkwardness of adolescence.

Gentle rain drummed the metal roof of the building. Inside, we sat on metal folding chairs like those found in church basements everywhere.

Bear Pond Improvement Association Meeting of June 28, 2009

The chairs were spray-painted that bland shade of institutional brown, and stenciled with BMC. Straight ahead was a basketball hoop. To the left was a giant American flag, protected from lost dribbles, bad passes, and blocked shots by a rigid sheet of Plexiglas. To the right was a folding table with two half-empty boxes of donut holes and cardboard containers full of "Joe," otherwise known as coffee.

This was a meeting of the Bear Pond Improvement Association, one of thousands of independent, non-profit lake associations in the United States. Each is devoted to protecting its own little slice of heaven. Though Bear Pond is technically a lake, residents here in New England (a.k.a. "greater Lake Walden") insist on calling it a pond. They also insist on calling every waterfront domicile a "camp," regardless of construction technique or grandiosity. In the Upper Midwest (a.k.a. "greater Lake Wobegon,") all such structures would be called either cottages or cabins, depending on their rusticity.

Just before the meeting, Kristine, a Maine native, asked those behind her if they'd ever

seen a bear around here. "Nevah," came the reply in an unmistakably thick Maine accent. These are local folks, some of whom have been summering here for generations, perhaps since the town was founded in the late 18th century. This place is so old that local lore is divided over how the name Bear Pond originated.

Presiding over the meeting was James Adams, a local realtor about my age wearing a duck-boat-drab colored T-shirt, and who had driven to the meeting in his shiny black pickup. Next was a moment of silence held for loyal members who had "passed on during the winter." In one case, the family of a recently deceased matriarch, asked that donations be given to the lake association in lieu of flowers and gifts to help protect her favorite spot in the world. That $535 brought the treasurer's balance to $10,930, some of which will be used to buy the water-quality testing equipment now required by the state.

The balance of common loons (Gavia immer), however, was only five, consisting of two mated pairs and an old bachelor male who is allegedly as old as the hills. The chairman of the loon committee, a silver-haired guy named Pete, bore the sad news that their new mother loon had inexplicably left the nest, perhaps due to rising water or molestation by curious teenagers. They also reported that wildlife officials from throughout the state had sent approximately 200 loon carcasses that year to a veterinarian at Tuft's University for autopsies. Half of these iconic creatures, the doctor reported, died of lead poisoning, either from shotgun pellets or lead sinkers left years ago. Fifteen percent died from entangled monofilament line.

On other environmental issues, the water-testing committee presented positive results, especially with respect to the visual clarity, which was nearly 20 feet using a standard method known as the Secchi Disk. The dissolved oxygen level was good, and the samples for phosphorous had been sent off to the lab. Surveys for invasive species had confirmed that the lake remained free. Finally, the Lesley Wright committee, which "kinda formed yesterday," reported a plan to keep a patch of donated land "forever wild."

Bear Pond straddles two sovereign entities, the town of Hartford, which claims 149 house lots, and the town of Turner, which claims 62. Accordingly, regulations are different on their respective sides. Tax assessments are different. Demography is different. But here at the meeting, the only community that matters is the circle of people united by a common love of the lake. Though Maine considers itself a saltwater state, one would never know it from the conversations I heard that day in North Turner.

In terms of development, water quality, and wildlife habitat, the residents of Bear Pond and most New England lakes are lucky, respect to the nation's lakes, as reported by the recent National Lake Assessment. More importantly, their lake association is in even better shape. Its members neither want nor expect the federal, state or town governments to do their work for them. They give me hope that, one lake at a time, America will return its recreational lakes back to the standard they deserve.

I did have one concern from the meeting. I saw nobody under forty, and most attendees were at least sixty. There was more than enough adult wisdom to go around. But what

happens when these folks are gone?

Swimming

The Boofy Quimby Center was the geographic start of our journey, its most northeasterly point. We didn't travel very far on our first day. In fact, the net distance was no more than two miles: west across Maine Route #4 to the home of Rob and Liz Hoy, my brother in law and his wife. From there, we learned it was a long way to Reserve, Montana, the most northwesterly point of our trip, where some wheat fields are nearly the size of some New England towns.

I asked them to hold up the map I was using to guide our journey: *Glacial Map of the United States East of the Rocky Mountains*, published by the Geological Society of America in 1959. It remains a remarkably good resource.

Rob and Liz Hoy standing on their deck in front of a small kettle pond and holding up our glacial travel guide in North Turner, Maine.

After the meeting, I asked my grand nephew Calvin what he liked best about fresh water. "Getting wet," is what he said. It was raining so hard that we could have easily gotten wet just by standing outside. Nevertheless, I had already decided that taking a swim in "greater Lake Walden,"' would complement the one I plan to take in "greater Lake Wobegon,"

Robert Thorson emerging from Bear Pond, in North Turner Maine.

The water was surprisingly warm for this time of year. Given the high humidity and small size of the drops, the temperature of the rain falling on the lake surface was similar to that of the air itself, in the high sixties. And given he calmness of the wind, this warm water could simply float upon the colder stuff down below. A lake may consist of nothing but water, but that water is usually layered. By late summer, and in deep lakeks, a thick layer of warm, wind-stirred water known as the epilimnion usually floats above much colder water sent down during early spring melt.

Solid Water

Taking in the association meeting on a Sunday morning and leaving early Monday required that we spend two nights up north. Having been fed by my in-laws the first night, I volunteered to cook dinner on the second. This required a round trip of several miles to the nearest grocery store in Turner.

The most exotic place I passed on the way was an antique snowmobile museum. Not only were machines inside antiques, but the museum itself looked like an antique, perhaps not longer visited, or even maintained. Seeing the museum helped me imagine the previous winter. A fluffy mantle of white snow lay upon the ground, its billions of crystals tangled together.

To most people water is something you can drink. Ice is something you can't. But to scientists, ice, snow, and rain are simply different manifestations of the same molecule. H_2O resembles a Mickey Mouse cap, having a pair of hydrogen atoms for ears on one end, and the much larger oxygen atom for a head. On earth, this compound occurs naturally as solid, liquid, and vapor, none of which is more or less watery than the other. In fact, the most common chemical phase of fresh water on earth is not liquid, but ice

locked up within the Antarctic and Greenland Ice Sheets. The same is likely true on the Moon. The search for life on Mars is really a search for water, which is really a search for ice. In fact, the word "ice," from ancient Greek, originally referred to any crystal, even quartz. Ice is indeed a crystal, which makes water in that phase a mineral. This makes ice sheets giant piles of rock soft enough to flow slowly

Snow, of course, is nothing but a fluffy or granular form of ice. soft enough to give way physically, but firm enough to provide some resistance. This explains why the snowmobilers of winter can cavort upon it as do the jet skiers of summer cavort on the surface of a lake.

The sales of snowmobile sales are way down across the nation. Those of jet skis are also in delcline, but holding much steadier. Could this be a harbinger of climate change? Will snowmobiles of the glaciated fringe eventually go the way of typewriters?

Water Business

Before reaching the grocery store, I passed two well drilling companies, a construction-excavation company, and at least three sand-gravel quarries. All are connected by the water cycle.

Throughout the glaciated fringe, we can turn on the tap and clean water appears as if by magic. Flush a toilet, and the dirty water disappears. Out of sight, and out of mind. Because most Americans live in metropolitan areas and small cities, few know where it actually comes from and where it goes when they're done with it. But along Maine Route 4 north of Auburn, the chances are that at least one person in every household I drove by knows about these comings and goings because each is responsible for its own water supply and wastewater disposal. Getting that water requires hiring a drilling contractor, which explains their presence along the road. And in spite of the local competition, they don't come cheap, which explains why there is competition. A homeowner can easily spend up to ten thousand dollars to drill a household well, and with no guarantees regarding the quantity or quality of the water.

Getting rid of that water is usually even more expensive. Beneath every non-chemical and non-composting toilet in the nation is a drain carrying that which none of us want to see. In cities and towns, those drains merge underground, forming a complex tributary network of bigger and bigger sewers that flow into a wastewater treatment plant. But in Turner, Maine, those individual drains usually head to an underground tank where the solids settle out. The liquid overflow moves out to a series of porous pipes that let the wastewater trickle through permeable soil in what's known as a septic system.

This is where the sand and gravel quarries come in. If your soil is too clay rich or too dense, a homeowner can solve the problem by importing and spreading sand on the drain field, through which the wastewater can filter and be acted upon by bacteria. The sand there is permeable because it had been rinsed free of mud by flowing glacial meltwater before ending up in flat-topped deltas and on the sand bars of ice-age streams. (consult the Maine Geological Survey for details). Unfortunately, the wastewater is not always rendered pure. In fact, I suspect that a fair proportion of the pollution that reaches Bear Pond arrives from the camps of perfectly nice people who are unaware that their wastewater facility is mal-functioning.

The first night of our trip passed uneventfully. The food was fine, the company pleasant, and the sleep deep.

Day 2 –Maine & New Hampshire

Dreary sky greeted us for the second day. We drove away with our windshield wipers on. Cars swished by us enveloped in sprays of mist. The aquifers were being filled to capacity. That should keep the springs flowing all summer long.

Our plan was to drive south through Maine's lake district, northeast into the foothills of New Hampshire's White Mountains, then south to Northwood, New Hampshire, where we have a reservation at the Meadow Farm Bed & Breakfast, an 18th century historic home. We wanted to wake up within easy striking distance of Walden Pond, yet avoid the busy corridors near the Atlantic shore or and along the Nashua-Merrimack River system northeast of Boston.

Bottled Water

Poland Spring was founded in 1895 as a Victorian era resort in Poland, Maine. What drew urban residents to the place was a flowing bedrock spring alleged to have had restorative properties. The original spring is still there on the flank of the hill. It's identified as "The Source" and housed within a beautiful cut-stone building called the "Spring House." At that time, this may have been the Holy Grail of freshwater in the northeast.

Even today, Poland Spring water remains world famous. But something very curious is going on. On the way to The Source, we passed a large bottling plant for Poland Spring water, tucked off the highway behind the trees. If the water from the spring were indeed the water being bottled at the plant, then one would expect to see either a pipeline (which didn't exist) or a steady stream of trucks moving between the two. We saw nothing of the sort when we staked out the scene. Instead, and as a matter of public record, the water being bottled there and in other plants is pumped from aquifers similar to those of most municipal water supply systems. In other words, Poland Spring Water doesn't come from the spring. Instead, it's a wonderful brand name for what is otherwise ordinary clean water coming from a variety of industrial-scale pumping stations.

If a company as large as Poland Spring were actually run out of its original location, then its corporate headquarters building would be much larger than the tiny steel frame building found near the source today. The reality is that this water company is run by Nestle, a multi-national conglomerate operatingi for the benefit of stockholders, most of whom have probably never seen the namesake spring. Effectively, Poland Springs water

is very much like Coca Cola without the added ingredients, a brand name rather than a local substance.

Springhouse at Poland Spring Preservation Park, labeled "The Source."

In the case of Poland Spring, a good idea became a bad idea. Drinking water from the original trickle of a bedrock spring and bottling it for small-scale distribution was a great idea in 1895 before automobiles and plastics were in widespread use and before adequate urban sanitation. Today, petroleum products are used: to pump not-so-special water from unrelated aquifers around the state: to make the plastic for the bottles that are used; to ship those full bottles around the world to retail stores; and to have that water hauled back home in personal automobiles. On top of this is the traffic congestion caused by the delivery trucks, the air pollution caused by their exhaust, the energy used to recycle the bottles, and the space they take up in landfills.

One hour earlier, my brother in law -- who's an attorney -- told me about a 1986 court order allowing this multinational corporation to draw millions of gallons of water each year from nearby Range Pond (pronounced Rang) to rinse its newly manufactured bottles before returning the effluent back to the Maine environment.

Sebago Lake Country

After Poland Spring, we headed west toward Sebago Lake, one of Maine's most visited lakes. Its shape is oddly circular for a region with so many elongated coastal bays and inland lakes like Moosehead and Rangeley. It turns out the shape is due to the presence of an enormous round dome of fractured granite, the blocks of which were quarried out the glacier, leaving a deep, cold, and unusually pure lake.

Looking down on the northeastern corner of the lake is the town of Raymond, This is where Nathaniel Hawthorne, famous transcendentalist author and friend of Thoreau, summered as a child. Crossing the gauntlet of the massively developed strip of North Windham, we arrived at a state boat launch on the lake shore in Standish. While framing a photograph, I noticed a piece of plastic litter that I removed from this otherwise beautiful scene. It was a spent shotgun cartridge, dotted with black makings on the inside, where the heavy shot had been held. Though lead shot is now outlawed, much of it remains as a contaminant that bioaccumulates u the food chain.

Our next stop was Cumberland County YMCA Wilderness Day Camp at Otter Ponds.

Otter Ponds Camp, Standish, Maine.

Here, kids are dropped off by parents and bussed out from the city where they can experience life in the woods and be immersed in the purest pond water I have ever seen except for rocky tarns in high mountains.

Sebago is known as a very clean lake, largely because of its great volume relative to its surface area and the limited pollution potential along its shore and in its watershed. The Otter Ponds are a cluster of small, water-filled kettle holes located on a ridge of sand called a moraine, responsible for damming Sebago to its present level. Luckily for the kids, the clean water from Sebago drains through the moraine as groundwater, which acts as a sand filter. Thus, every kid who goes to camp at Otter Ponds experiences the ultimate in pure pond water. I hope they don't get spoiled in the process. It doesn't get any better than that.

After reaching the southeast corner of the lake, we headed west into New Hampshire

through the lovely village of Cornish. There, we found three antique stores, three ice cream shops, and three boutiques, all within one city block -- the only one in town.

Main Street (U.S. Route 25) in Cornish, Maine.

Continuing west along the Ossipee River on Route 25, we turned north at Freedom, New Hampshire and then north toward Conway.

Ossipe River near Freedom, New Hampshire

The rivers run clean around here for all the typical reasons. They have forested watershed with low human populations, are fed by aquifers charged with snowmelt, and drain soils derived from resistant metamorphic and igneous rocks that release few dissolved compounds.

Purity Springs, New Hampshire

Author Richard Louv would probably like Purity Springs, based on what I read from his "Last Child Left in the Woods." I recommend his book and this family resort to those who are concerned that kids are spending too much time indoors. He documents that when children have limited access to nature, they become more prone to physical, neurological, and psychic harm. They also become desensitized to non-human organisms and environments. This is not a good thing.

As luck would have it, Kristine and I drove by just as two adults and two middle school boys were crossing the road, carrying fishing poles and a tackle box. We decided that this would make a great photo if we could convince them to stand beneath the sign. Luckily, they consented.

Family fishing at Purity Spring Resort, Purity, New Hampshire.

The pair of dads, each with a son, was returning from time spent catching and releasing eight pickerel and one perch. It turns out that one of the dads has vacationed at the resort for 43 years. I extend my congratulations to these dads for teaching their children well, to their granddads for teaching their fathers, and to the owners/operators of this low-key family resort who provide such wholesome outdoor family fun. Water, of course, is the key. The resort would not be there without it.

Eaton, New Hampshire

Consider the charmingly unpretentious Eaton Village Store shown below, which someone told me was the only commercial property in town.

Eaton Village Store, Eaton, New Hampshire.

It's tucked away along the edge of Route 153, in the pleasant, but un-majestic hillsides and forests near the eastern edge of the state. This is a place with stone walls, tiny cemeteries, and overgrows orchards so typical of forested land that formerly was cleared for a rural civilization based on agriculture. On the porch of the store was a chair painted as an American flag.

Chair at Eaton Village Store, Eaton, New Hampshire.

Inside were the post office, a selection of essential items, a few curios, and a folksy café run by a matronly cook helped by a teenager . Across the street were some dilapidated tourist cabins fronting the lake that had attracted our attention enough to stop. We wanted to know the water story behind cabins abandoned in such a beautiful place.

It turns out that the village store became caught between a rock and hard place in terms of community wishes. The story I heard was that local folk wanted the café-post-office-general store to stay in business to meet their needs, but also wanted the lake to remain crystal clear, and free of excessive algal growth. The pivot point for this dilemma was the septic system of the present café. It was polluting the lake with excess nutrient because it was too small to meet the needs of those who stopped by.

The solution appeared in the form of a purchase of the property with the dilapidated cabins by a couple from Virginia related to someone in town. They granted an easement to the store for wastewater disposal, while reserving the right to build a shoreline home appropriate for the property. The town and state governments stepped up to the plate to do what they could. It was if the community had waved a magic wand, saving both the store and this part of the lake watershed at the same time.

Let the story of the Eaton Village store stand as a symbolic victory in the tussle between commercial development and environmental regulation. With local interest, creativity, government cooperation, and good will, those of us who love America's lakes can have our cake and eat it too.

Madison, New Hampshire

Lee Pollack is a retired zoology professor who lives on the shore of Pea Porridge Pond.

Pea Porridge Pond, Madison, New Hampshire.

I could write a magazine article based on the conversation the two of us had that day

about what he and several of my geological colleagues are doing in their spare time. Within the last few years, they somewhat accidetally created the Madison Lakes Paleoecology Project. Its goal is to reconstruct the entire history of this small lake, a history that began with the block of glacial ice that melted to create the present pond, on which no motorized watercraft is allowed. Lee's job as a volunteer science-citizen is to identify the microfauna and other invertebrate critters (mostly zooplankton) that have been living in the pond since it was created about 13,000 years ago. Their physical remains were extracted from a deep sediment core taken through the ice from the center of the lake.

Lee Pollack in his closet office, Pea Porridge Pond, NH.

Based on the pollen records, the land surrounding the pond was first tundra, then a spruce-pine parkland foraged by Paleo-Indian groups, then pine forest with Archaic native Americans, then the mixed northern hardwood forest of the Woodland Indians and early Europeans. Based on the diatoms and invertebrate fossils, the water began ultra clear, and then has shifted back and forth ever since, with a trend toward slight -- but recent-- pollution in the last century or two. In 1765 the 2000-acre block of land, originally known as McNeal's Location, was given to one of the Rodgers Rangers in lieu of pay for their military service in the French and Indian War. Now the tract is mostly divided up private land, held as a series of lakeshore properties around a lake. The origin of the name Pea Porridge Pond remains a mystery.

Currently, there is no lakeshore association. I suspect that one will come sooner, rather than later, perhaps because of the lake community's shared interest in the deep history of this place. Professor Pollock put it well when he said that the most amazing thing about his pond is that "people are so involved in the puddle in their front yard."

On the more general question of what he likes best about fresh water, it's that the water landscape is so rich in history. On the down side, and on the short term, he's most

concerned about the high water, which "washed the loons away." Beaver dams have been a problem in raising the water, but so has the heavy recent rains.

Heading South

We headed south toward Northwood, our evening destination. We passed through the historic resort town of Moultonboro, on Lake Winnipesauke, New Hampshire's largest body of fresh water. With no time to spare, we didn't even bother to stop. Nearing Northwood, we became adventurous enough to take some roads marked with the thinnest ink on my atlas maps, which turned out to be dirt and gravel. Owing to the heavy rainfalls of the past month, they also turned out to be impassable.

After three failed attempts to find a shortcut, we took the long way around to Meadow Farm for what turned out to be a sandwich dinner, eaten on a screened porch while sitting on twig furniture and listening to the steady drizzle.

Day 3 – Literary New England

We woke up in a canopy bed at Meadow Farm, in Northwood, New Hampshire. Even before our blueberry pancake breakfast, I knew we made the right choice. Kristine and I both had trouble sleeping, our brains overloaded with the sights and sounds of the previous day. Already, I had learned that issues involving freshwater are nearly everywhere one looks.

The task in front of me was to finish the blog before checkout time and setting off for two literary spots in southern England, Robert Frost's farm in Derry, New Hampshire and Henry David Thoreau's Walden Pond in Concord, Massachusetts. I barely got started before falling into conversation with two excited but unrelated kids being dropped off for summer camp at a nearby lake. Each was accompanied by a parent, who were carpooling up from New Jersey,

At breakfast, the dad held up a kettle, in honor of my recent book on kettle lakes and ponds, "Beyond Walden."

Breakfast at Meadow Farm, Northwood, NH.

That morning I posted my entry using a jump drive plugged into the back of an old Dell computer programmed for the Windows operating system, which was behind a desk in an

old hayloft of an even older barn. Before departing, we took a walk to several lovely spots within a few minutes time, most importantly to the beautiful shoreline of Jenness Pond.

From our B&B dock at Jenness Pond, Northwood, New Hampshire.

South to Robert Frost Farm

Our trip began with some of the most challenging driving of the trip. In the Dakotas, the county roads are wide, ram-rod straight, and run for many miles between even small towns. Here, the state highways are often narrow, windy, and are constantly crossing through towns whose road network was laid out in the ancestral, spoke-like pattern. In Northwood, it seemed, all roads led to village centers, which were usually marked by a church and an old general store. Water towers, we later realized, were conspicuously absent,

Northwood, NH, heading south.

We kept winding right into Derry, New Hampshire, where we stopped at the Robert Frost Farm. Former poet laureate of the United States and New England's most famous sage, Frost lived here with his family during the first decade of the 20th century while running a chicken farm.

What's left of his home and farm is a lovely, but small New Hamsphire State Park consisting mostly of a white clapboard farmhouse, the barn, and the adjacent fields that so inspired poetic thoughts.

Robert Frost Farm in Derry, New Hampshire. Our faithful travel vehicle is barely visible behind the barn.

I've given two slide-show lectures in this barn, one without electrical power (when it was knocked out by a thunderstorm, which meant that my slides were invisible), and one with power, which meant we could see them.

Attending both talks was a jovial guy named Bill Gleed. Besides being the park manager, he's also a published poet and my personal guru for all things Frost. I suspect he knows the man and the house in such detail that he may have memorized how many teeth were in the old man's comb.

Though Bill refused to admit it, I think he preferred the talk I gave without slides, given its "Now What?" urgency, creative spontaneity and diversionary tactic about Robert Frost being a "closet geologist." As a student, Frost had been greatly inspired by Nathaniel Shaler, his geology professor at Harvard, who is also one of my favorite overlooked historical characters.

"Something there is that doesn't love a wall…. Good fences make good neighbors." Those phrases are from "Mending Wall," unquestionably the most famous poem about the abandoned stone walls that grace New England's countryside. I've recited it many times as a speaker.

Another famous Frost poem is "Stopping By Woods on a Snowy Evening," which begins with the line "Whose woods these are I think I know." I bring this poem to your attention on a freshwater journey because it's a chance to remind readers, once again, that snow and ice are both made of water. Also, according to the Frost farm resident expert Bill Gleed, nearby Beaver Pond is quite likely the inspiration for the "frozen lake" mentioned in this section of the poem:

My little horse must think it queer.
To stop without a farmhouse near
Between the woods and frozen lake
The darkest evening of the year.

Beaver Pond in Derry, New Hampshire may be the source of inspiration for the poem "Stopping By Woods on a Snowy Evening."

Before I left, I asked Bill an unusual interview question: "If Robert Frost were here today and I asked him to say something about fresh water, what do you think he would say?" Bill admitted it was a tough question and then, with a slight accent reminiscent of Frost, gave three short answers in this order, which I copied verbatim: "Water is essential to farming. Lots of my poems have fresh water in them. Water is the essential blood of the planet."

Walden and Concord

Just west of Derry, we jumped on the Interstate 93, which merged with Interstate 495, and glided over the area "North of Boston," which is a famous book title by Robert Frost. This is an area of wall-to-wall suburbs surrounding four historically separate cities: Boston, Haverhill, Lawrence, and Lowell, Massachusetts. These suburbs might be enjoyable to live in, but are not easy to cross when time is of the essence.

At Lexington, we headed west to Walden Pond on Highway 2A, which parallels the "Battle Road," the stone wall-lined path taken by the retreating British regulars following their armed exchange with colonial minutemen at the Old North Bridge in Concord. This "shot heard round the world" was fired on April 19th, 1775 -- a story made famous by Henry Wadsworth Longfellow's poem "Paul Revere's Ride." The history is now very well told by the staff, signage, and literature of Minuteman National Park.

Concord, Massachusetts is the oldest inland town in what turned out to become the United States. It was founded in 1635 by farmers attracted to the "Great Meadow," a mosaic of freshwater marshes that provided hay for the earliest cattle, and which could be carefully managed as productive tillage bottom land. The story of this place, captured by a colleague and environmental historian Brian Donahue in his prizewinning book of the same name, is also a story about frozen and unfrozen water in the form of ice-sheet invasion and the seasonal inundation of what used to be a ribbon-shaped glacial lake.

Henry David Thoreau died in 1862 in this house in Concord, MA.

Walden Pond was the highlight of the day's trip, even though I've been there many times before. What made it special were the people I interviewed.

An anonymous mom at the kid's swimming area provided just the right balance between sharing her young son with the world and protecting him from the bad things that might happen when a complete stranger walks up and wants to take a picture of her son. I don't know her name because she didn't give it voluntarily and I didn't presume to ask. Imagine the scene. A lone male with an oversized camera walks right up and asks if he could photograph her sun for publication on the Internet. What would any prize-winning mother do?

Fortunately, my business card, doesn't list "middle-aged creep" or "child molester" among my academic positions. I introduced myself before explaining my purpose: to blog the hydrosphere from Walden to Wobegon, which probably sounded pretty strange, now that I look back on it. Eventually, she consented, though her son did not, refusing to return to the water or look at my camera.

Child at play at Walden Pond, Concord, Massachusetts, looking west.

Before leaving the beach, I did something symbolic that borders on superstition. I collected some water from Walden so that I might pour it into Lake Wobegon when I get to Minnesota, and vice versa.

Overlooking the pond are the headquarters of Walden Pond State Reservation, managed by the state park system of the Massachusetts Department of Conservation and Recreation (an agency title that gets its priorities straight). There, I talked with supervisor Sandy Libby. She's the antithesis of the cardboard version of the "state worker" (a slacker employee on the taxpayer dole), being hard-working, resourceful, decisive, and, in my case, very helpful.

"What's most special about Walden Pond," she said, "is that they get the widest variety of people of any other state park." People come from every continent and country, speaking languages that doesn't knowo exist. This, of course, is testament to the pond's international reputation as a shrine to environmental thinking. More than 150 years ago, Henry David Thoreau set an example that we, as a nation, have yet to follow. Its hard to think of our nation's attempt to preserve water resources without thinking of Walden Pond first.

According to Sandy, we "Thoreauvians," are only one of three largely separate groups, who visit the pond. Also present in every season are those who use the pond to recreate. They range from serious athletes (triathlon trainees in wet suits who use the pond as a giant swimming pool and marathoners in lycra using its trails for daily workouts) to the chubby guy eating a picnic hot dog while most of his body is submerged like a hippo (I'm a witness). The third main group consists of those who come to enjoy Nature in what has become a fairly crowded, and increasingly gentrified town. Concord is on the railroad commuter line to the "Athens of America," but seemingly removed from urban woes. The subtext of this observation is that it's an expensive place to live.

I also talked with Michael Mitchell, Director of Interpretation for the State Park. This title means exactly what it says. His job is to interpret what is known about the pond, the woods, and the American history, and re-package it in such a way that different groups can understand it. A self-described city kid from nearby Lowell, Mike's career began when he was a seasonal (read "summer") employee doing jobs like picking up trash, clearing trails, and monitoring humans not following the rules.

When I asked Mike what his biggest challenge was, he replied: "trying to reach out to inner city youth groups." He went on to explain that this challenge isn't so much about the kids – some of whom are emotionally moved and profoundly changed by the simple experience of standing in the quiet, lakeside woods -- as it is about finding the money and mechanisms to get kids off the streets and into the park. This, to my mind, is better way to spend tax money than fixing a few more potholes (in the pavement).

The last person I talked to at Walden Pond was an intense, but thoroughly fascinating and helpful guy named Richard Smith. Trained as a historian, his "main" job is performing impersonations of Henry David Thoreau around the country. His "day" job is to be the manager of the "Shop at Walden Pond," which is run by The Thoreau Society, of which I am a member. (When I was there yesterday, I signed copies of my recent book, *Beyond Walden*.) Members of the society can be though of as those who care about Thoreau enough to pay dues to an organization devoted to him. Alternatively, think of us as members of an Audubon Society devoted to a biped without feathers.

When there, Kristine bought a stuffed toy loon distributed by the National Audubon Society to be a mascot for our trip. When squeezed, it does a very good imitation of the haunting wail that so captivated Thoreau when he lived here in the mid 1840s.

A Water-Powered Revolution

After an early supper in Concord, we traveled south toward the industrial mill village of Harrisville, Rhode Island.

Milldam in Harrisville, RI, built of enormous cut granite stones.

To get there before dark, we had no choice but to take Interstate 495 between Marlboro and Milford, Massachusetts, which parallels the town-after-town stretch of Route 85. We were late because I was submitting, and reviewing my regular newspaper column to the Hartford Courant (the nation's oldest continuously published newspaper) on its deadline day.

Rhode Island, the smallest state in the Union, is basically the land surrounding Narragansett Bay and the islands within it: Aquidneck, Conanicut, Prudence, Dutch, Hog, and many others. Having lived three years in Seattle and having mapped components of northwest Washington for the U.S. Geological Survey, I've come to think of Narragansett Bay as a sort of upside-down Puget Sound, but with the glacier creeping down the bay instead of creeping up it, respectively. The rocks of both basins are as similar as

Though located in the Ocean State, there is nothing salty about Harrisville. In fact, flowing freshwater, both here and in the adjacent Blackstone Valley, was the lifeblood of economy in the 19th century. Power was the key. And hydropower was the best power available in the age before fossil fuels. Here were clear streams flowing perennially over hard rocks, providing thousands of profitable opportunities to tap the solar power of the hydrological cycle in order to run mill factories to weave, stamp, grind, polish, cut, shake, and crush whatever needed to be done. High quality granite was available to quarry building stone for milldams, canals, raceways, and mill foundations. At rock narrows, pre-existing rapids and small waterfalls could be easily exploited and managed for waterpower. Finally, in rocky country, streams are generally free of sediment, which might otherwise clog up the works.

The small mill town of Harrisville, Rhode Island, is one such place. There, the center of human life was not the church, but the mill and the dam that powered it. When we think of fresh water today, we usually think of drinking, flushing, and recreating. But scarcely a century ago, people nearly everywhere in New England thought of water as the source of power.

Westward Home

We had arrived after dark in Mansfield, Connecticut, where we've lived for more than twenty five years. Mansfield was settled in 1695 as "Ponde Place," after the many kettle ponds on the sand plain a few miles to the south. This settlement branched off from the nearby town of Windham because residents got tired of crossing the Natchaug River on their way to Sunday Sabbath. So may town histories in New England involve fresh water.

Our house is a fairly non-descript brick ranch built on a lot carved out of an old pasture of an old farm. This, along with New England's famously stony glacial soil, explains why our patch of ground is surrounded by stone walls, which are visible from every angle. The yard is sodden from last night's rain. Here our entire neighborhood drinks water straight from the tap that comes from individual wells. Ours comes from bedrock fractures at a depth of about 250 feet below the surface. There's no water tank or cistern here like there used to be. Like everyone else, we use a pressure tank instead. What that means is that when the power goes out, so does the water.

At breakfast, I decided to interview myself about the highs and lows of water. On the plus side, living on the crest of a hill helps keep our water clean because infiltrating water moves outward in all directions. My down side involves the local version of a crazy idea: using water to irrigate fairways and greens of golf courses.

For the last two years, I've been the unofficial water expert for our neighborhood association, which is up in arms because of the University of Connecticut's plans to do raise golf course turf grass on the abutting experimental farm. Their plan is to drill three deep bedrock wells in order to suck up tens of thousands of gallons of water per day in order to irrigate experimental plots of grass, in order to see which will work best for golf course fairways, an industry now on the decline.

Eventually, their water expert (a faculty colleague of mine who teaches groundwater hydrology) convinced us that there was enough water to go around and that surface pollution won't affect our wells. My neighbors, however, remain quite circumspect about assurances provided by a university that recently sucked an adjacent river completely dry when they over-pumped the local aquifer, killing many fish and alarming those of us who rely on private wells. As an individual with some sense of how the earth works, my main concern is not the hydrologic details – drawdown curves, hydraulic conductivities,

specific yields, etc. --- but the absurdity of promoting golf course irrigation in parts of our country that are running low on water.

It's one thing to play golf in the well-watered northeast. It's quite another to irrigate golf courses (or suburban lawns) in the desert southwest, where conflicts over this precious resource are raising taxes for everyone and creating international conflicts. California is a water disaster waiting to happen to tens of millions of people. No course truly needs irrigation. As a kid, I remember playing on a course on the prairie with sand greens and brown fairways. As an adult was a golf course built for officers of General Augusto Pinochet's army in the Atacama Desert of northern Chile. The fairways were dust, the greens were patches of sand surrounded by stones spray-painted green, and the water hazards were identified by stones painted blue.

For the last time in weeks, I hit the proverbial hay in my own house.

Day 4 – Western New England

Today would be the first day of the trip we didn't wake up to the sound of rain, though it did manage to do so before we left late that morning.

My first order of business was to copy and cut a stack of business cards on which I wrote down the blog address. These, I would hand out to anyone I approached for an interview. I also spent half an hour having my picture taken for a newspaper article about a trip that was already underway.

Eastern Highlands

Mansfield is full of quirky little ponds and meadows nestled in low spots within the rolling bedrock hills.

Valentine Meadow, University of Connecticut, Mansfield, CT.

The stripe you see running through the grass is an artificial drain, dug during the 19th century when the land was being converted for agriculture. Before it was a meadow, it was a wooded swamp, and before that, a marsh, pone, and glacial lake. This succession of changes is completely normal, for the fate of practically all lakes is to be filled with sediment from the surrounding landscape and from organic remains of aquatic organisms.

When the town was first settled, the swamps were preferred targets for land sales. On them, especially during winter, one could easily cut cedar for fence posts and pine for framing timber and get the logs out easily. The peat and muck were used as manure, and had bog iron for the earliest -- and always square – wrought iron nails.

Leaving town, we crossed the northeast highlands passing through the towns of Willington, Tolland, Ellington, and Somers, which are more alike than they are different. Three hundred years ago, each was a community unto itself by freedom-seeking peoples shaking off the restrictions associated with their Puritan forefathers, and moving toward the independence of the Minutemen.

We stopped at Crystal Lake, in Ellington. There, we saw gosling geese swimming in front of a massively over-developed shore. My photos were burry, which I thought was due to the rain. I figured out why the next day. I had accidentally, flipped the switch on my camera away from auto-focus to manual focus, which I had trouble doing in the heavy rain of many stops.

Quinnehtukqut

Connecticut is an anglicized version of an Algonquin word for "land beside the long tidal river." The Connecticut River, New England's longest, originates in southern Quebec before flowing 400 miles to its saltwater estuary in Long Island Sound. The river occupies a the Connecticut River Valley, a broad geological lowland containing layered sedimentary rocks that are much less resistant to erosion than the much harder igneous and metamorphic rocks holding up the highlands on either side.

The soft rocks were deposited within an ancient rift valley of Jurassic age, and are therefore full of dinosaur footprints. Also present are mud-cracks, lime nodules in ancient soils, and a deep barn-red stain. Collectively, these features point to internally drained monsoon lakes that rose rapidly in response to drenching rains, and fell gradually as their waters were baked away by the tropical heat. These "brownstone" rocks full of stories about freshwater, the overflowing lakes, the erosion of adjacent, mountains, and the sandstone now being carved away.

Two hundred million years later, and the highlands are still landscapes of erosion, their valleys cut by waters of time and rendered chaotic by the arrival of at least three ice sheet invasions,

For thousands of years, The Connecticut valley was occupied by a ribbon-shaped glacial lake. Now only small versions of those impoundments lie behind its many dams, most of which were built after the hurricane floods of the mid 20th century.

Berkshires

Leaving Interstate 91 just west of Holyoke, we climbed uphill on the Massachusetts Turnpike to exit for Lee-Lenox, which gave us easy access to one of the most famous blue highways in the U.S.A., Route 7. This scenic road begins at Norwalk, Connecticut on the north shore of Long Island Sound, follows the Housatonic Valley through the Litchfield Hills and the Berkshires of Massachusetts, continues through the Valley of Vermont, crosses Lake Champlain, and ends at the Quebec border on the Saint Lawrence seaway. The entire stretch is underlain by marble, a soluble rock that has dissolved and washed to the sea.

Lenox, Massachusetts is home to the Gilded Age writer Edith Wharton and, more recently, home of the Tanglewood Music Festival. Listening to a summer evening concert by the Boston Symphony Orchestra while having a picnic supper on the grass and watching the lightning bugs flicker on and off is a wonderful experience. Lennox is also near the Berkshire town of Stockbridge, a favorite haunt of 19th century writers, notably Herman Melville and Nathaniel Hawthorne, and in the 20th century, the home and studio of illustrator Norman Rockwell.

So far on this road trip, I haven't met anyone more enthusiastically happy than Tony, whom I met at the boat launch at Laurel Lake, which straddles the Lee-Lenox border. The reason for his exuberance -- so he claims -- is not drugs or booze, or a recent success, but a steady diet of fishing in retirement.

Tony the fisherman and his wife, Laurel Lake, Lee-Lenox, Massachusetts.

Fishing, he says, is the best thing about freshwater. Four days a week on average he

drives to the boat launch to spend several hours to fish from the edge of a parking lot. This is a nice lake, though hardly a spectacular one, being banked right up against the road, where the intermittent traffic noise of Route 20 can be heard. I asked him why he fishes so much. His reply: “It keeps me from being bored. The relaxation. I might meet a few guys to shoot the – &$X#% -- with.” Then I asked him where he lived. He said he spent his whole life in New York City until recently, when he moved to Great Barrington where he had a buddy who ran a Bed & Breakfast. I suspect his exuberance had had nothing to do with fishing at all, but was a natural reaction of leaving urban work for the “Life of Reilly” in the country.

Tony didn’t offer a personal downside to fresh water. Instead, he pointed to a large boulder on the opposite shore called Perch Rock.

Opposite shore of Laurel Lake, Lenox-Lee, MA.

“That,” he said, “was where guy just committed suicide. He then went to his truck to find a newspaper clipping from the day before, June 27, 2009, which reported a recent drowning, though no mention of suicide. Clearly, too much water in the wrong place can be fatal.

What fascinated me most about this chance encounter was how utterly human his fishing experience was. The nice rainbow trout he showed me was a stocked fish, born in a hatchery, fed with fertilized agricultural products, protected from predators, conveyed to the site in a tanker truck, and released into the pond. After spending some time in the water, the trout was lured to take the hook by a floating green gob of "Exclusive Power Bait," manufactured by the Power Fishing Company in Spirit Lake, Iowa. This state may have the highest concentration of fishermen per unit lake. Think of it as a moldable and insoluble marshmallow that fish just happen to like.

Today's variety of Power Bait was labeled “Chartreuse,” and perhaps it may have been

that color at one time. The thing that matters is that it worked.

Valley of Vermont

From Lee-Lenox, Route 7 continues north through Pittsfield, Massachusetts, where gasoline was $2.59 per gallon. In the morning, we would have passed through the shadow of Mount Graylock, which, at 3,491 feet, is the highest elevation in state. Today, in the rain, were no shadows at all.

Next in sequence were the cities of Bennington, Manchester, and Rutland, Vermont all of are located in the Valley of Vermont, between the Green Mountains to the east and the Taconic Mountains to the west. White marble seemed to be everywhere in the road cuts, especially at Pontoosuc Lake, between Pittsfield, MA and Bennington, Vermont.

Folk art moose in downtown Bennington, Vermont.

Eventually, we climbed over the headwaters of the south-flowing Housatonic River and entered the north-draining flow of the Hoosic River. This would hardly qualify as a drainage divide in the typical sense being so gentle.

Entering Brandon, Vermont, we began to enter country characterized by enormous north-south swamps more than a mile wide and up to ten miles wide. No doubt they were underlain by the clay of a vastly expanded glacial version of Lake Champlain, which prevents the water from seeping downward.

By nightfall we found ourselves at the historic Waybury Inn, located in East Middlebury, Vermont. Built in 1810 to house and feed weary travelers like us, it's now on the National Register of Historic Places. Haley, who works the front desk, says that this place is absolutely jam packed with: parents of Middlebury College students during the fall drop-off and graduation ceremonies; charter bus tours and bicycle tours during fall foliage season; and with weddings galore during the summer.

In fact, catered wedding receptions and newlyweds are so common that Room #9 has come to be known as the honeymoon suite. In it is an antique desk so old that nobody knows where it came from. In that desk is a tiny cubbyhole of a drawer. On June 27, 1987, a couple on their wedding night put a happy note in that drawer asking subsequent couples to do the same. "In time, over 200 eloquent and sometimes deeply personal messages would be left in the room…the writing is by turns passionate, philosophical, comic, and profound." That's a quote from the Inn's homepage.

Haley likes the Waybury Inn because it has spirit, imbued by her co-workers who came here for a job, but ended up staying for a career. After my first bite of dinner, my happy taste buds immediately let me know that the chef has had decades of practice.

About a century ago, the same restaurant was also pleasing the taste buds of poet Robert Frost, a frequent lodger and dinner guest. He passed the Inn twice a day when traveling between Middlebury College to the west where he taught, and his summer home in Ripton, which is only a few miles to the east. Ripton is where the famous Bread Loaf Language and Writers Conferences are held each August.

Another famous person connected to the Inn was the television comedian Bob Newhart. The Inn was the outdoor set for his sitcom, which ran from 1972 to 1978. I never saw it because, by then, I had taken an oath not to watch commercial TV. However, I do recall my father laughing his way through an earlier show of the same name in the 1960s whenever he got the chance to watch.

Building Permits

Our waiter that night was Rob, who lives in the nearby town of Salisbury, just a few miles away. What he liked best about the local water was that there was so much of it available. What he liked least was the great expense of getting rid of on-site waste water. Vermont, he said, has gotten so restrictive that it's difficult to get a home site approved. In fact, many private landowners who bought a lot to build on have been denied a permit

to build, owing to concerns about water contamination by on-site sewage treatment.

Before recent water pollution regulations, the main expense in building a summer home was the cost of materials. Now, even when a building lot is approved, he said, a homeowner can easily spend between $50,000 and $100,000 just to get a well drilled and build a wastewater system that will meet local approvals.

This makes perfect sense because Vermont prides itself as one of the "greenest," states in the nation, and is dominated by the Green Mountains. Respectively, the majority of voters want stringent regulations, and the majority of the land is in slope, some of it quite steep. There, soils that can meet percolation test requirements are uncommon and the rock is either heavily fractured, which allows pollution to seep away quickly, or water-tight, which forces wastewater to flow near the surface to a stream.

The Water Cycle

Writers, lovers, leaf-peepers, and travelers like me come and go from the Waybury Inn. So do water molecules. So, at dinner, I asked Rob where the Inn's water came from. Sheepishly, he said he didn't know, saying that we were the first guests ever to ask him that question. Unfortunately, his honest ignorance is all too familiar to me, someone who has taught entering first year college students for three decades. Indeed, water is often taken for granted. It shows up, it's used, and it's gone.

Being an experienced waiter, he asked someone else and got an answer before returning on his next trip to our table. The water comes from a small service company to the east that gathers snowmelt, rain, and groundwater from the forested mountainsides, conveys it down the valley in a hidden pipeline, and distributes the water to the Inn and village homes.

Brook in East Middlebury, Vermont running clear, even in flood.

From there it spirals down toilets, tubs, and sinks. But it doesn't disappear. Instead, it's re-gathered as wastewater and treated, before it is sent east on a gravitational journey to Lake Champlain. After spending a few years reaching the outlet of New England's largest lake, it spills into the Saint Lawrence River before heading northeast to the Gulf of Saint Lawrence between Quebec's Gaspe' Peninsula and Labrador.

Entry to the North Atlantic is only the beginning of an oceanic trip tens of thousands of miles long. The first leg is northward toward Iceland, as part of a broad surface current called the Gulf Stream. Eventually, this fairly fresh -- and therefore buoyant -- water is cooled by iceberg melt to the point where it becomes dense enough to sink to the bottom. There, it reverses direction and snakes its way southward the full length of the Atlantic as a bottom-hugging current. After a decade or two, that water finds itself somewhere between the Cape of Magellan at the tip of South America and the Cape of Good Hope at the tip of Africa.

From there it continues east past the Indian Ocean into the Pacific. Eventually it warms, rises, reverses direction, and heads back to the Atlantic as a surface current. Somewhere north of the Equator it will evaporate, leaving the salt behind. The vapor becomes part of moist tropical air masses that migrate northward as giant atmospheric eddies (that sometimes become hurricanes) before migrating inland to precipitate on Ripton. The timing is such that the water Robert Frost watched go down the drain in the early 1960s may have been the water that fell on us as yesterday's rain, or the water I watched go down the drain last night.

If you ever find yourself being asked where your water comes from, you don't have to be sheepish. Just confidently say that it comes from the Blue Planet, which recycles its water continuously,

Day 5 – Up and Over the Adirondacks

Having woken up too early to turn on a light in the room, I was writing in an upstairs alcove of the Waybury Inn. A fifty-something couple walked by on their way to breakfast. When they returned, I introduced myself to Brent and Kay, recent empty nesters (with 20-something boomerang kids) from Springfield, Ohio. They agree d to a brief interview.

Different Strokes

“Why are you here?" I asked. For them, it was the Bob Newhart Show, rather than the ghost of Robert Frost, which was my reason for being here. As fans of his1970s television show, they had put the inn as a priority for their first-ever trip to New England.

Being a baby-boomer with grown kids, I have lots in common with Brent and Kay. One of these is an appreciation of the state of Ohio, in their case as a nice place to live, in my case a fascination is the way their state’s glacial geology controls practically everything about its surface water hydrology. The northwest part of the state is dominated by flat, clay rich terrain that once lay at the bottom of the glacial Great Lakes. The southeast has the typical hills and "hollers" of unglaciated Appalachia, resembling nearby West Virginia. The middle of the state is a diagonal band of rolling moraines, kettle lakes, and highly variable local conditions. This was especially true for the Miami Valley, where they have lived for decades.

After my gratuitous, but fortunately brief lecture, I thought that Brent and Kay were about to return the favor by telling me about a favorite 1970s television show, but were kind enough to spare me the details. Instead they told me about the terrible beaches they had found on Cape Cod, full of unsightly rocks and bordered by enormous swamps. When probing further, these were the cobblestone beaches and salt marshes Cape Cod is so famous for. Different strokes for different folks, I guess.

I then switched tactics, asking them the more general question I've been trying to hone during the last few days: “Any thoughts about freshwater resources? Any joys or concerns about them?” The reply was "no, not really." Then, when saying goodbye, I asked them where they were heading. “Niagara Falls,” was the reply. That, of course, is

arguably the most famous freshwater site in the whole United States!

Literary Fishing

Another group was eating breakfast while we were. Two older men were having what conversation with two younger men and a woman that was replete with references to literary themes. Soon, the whole group had left to take an outside group photo before their departure. After I had finished my Eggs Benedict, however, I found the three younger ones still on the porch, drinking coffee and waiting for it to rain. I insinuated myself into their midst, gave them my business card, and asked my standard questions.

Nick and Mike were both English teachers at private preparatory schools from Dallas, Texas and Buffalo, New York, respectively. They were also alumni of Middlebury College's Breadloaf graduate school, visiting their former professor John Elder. He was the older gentleman facing away from me at breakfast. Elder is much more famous to me than Bob Newhart. Why? He is the co-editor of the *Norton Book of Nature Writing*, which I've used for years in my classes. Having wanted to meet him for years, I consoled myself with having at least met his backside. I'll get to see both sides this fall on November 22 when he will guest lecture for our course "Honors Core: Walden and the American Landscape."

I read Nick one paragraph from page 143 of *Beyond Walden*. In response, and with chagrin, he identified himself as a "walking stereotype." On that page, I described three kinds of angling: safari-style game fishing in saltwater; fly-fishing for native trout in freshwater streams with hand-tied flies; and fishing on ponds and lazy rivers, pejoratively called worm-dunking by purists. Having spent six summers in the Green mountains to get his masters degree, Nick, a preparatory school teacher from Texas, became a serious dry fly devotee. Lindsay was his companion, the woman I'd seen at breakfast. When I asked her what it was like to live with a fisherman, her first response was "expensive," which is when Nick said he was a "walking stereotype," with respect to the description I had read to him. Mike, in contrast, is no fishing gourmet. He goes after bass, pike, and sunfish, the most common fish across the glaciated fringe.

Lemon Colored Mud

The Champlain lowland is starkly flat compared to the mountains on either side. In the town of Bridport, VT, we were noticing an abundance of yellow houses and barns, but didn't know why. Then, we stopped to photograph a yellow-brown river in flood.

Lemon Fair River in Flood on July 3, 2009.

It turned out to be the Lemon Fair River in the town of Lemon Fair, which answered our question as to why even the stone buildings were yellow-brown.

Even the rock is yellow near the Lemon Fair River, Lake Champlain Lowland, Vermont.

Less than an hour earlier, we had left East Middlebury in the rain. Before leaving, I had photographed a rushing stream that runs through town. Even after nearly a month of steady rain, it was still running clear -- clear enough to see the cobbles of marble on its bed through slightly blue-tinged water. The contrast between that clear stream in the forested mountains and this muddy stream in the agricultural lowlands of Lake Champlain illustrate end members of the fluvial spectrum.

Fluvial is the word geologists use to describe rivers. As with more famous rivers like the Mississippi, the Lemon Fair overtops its banks because the slope of the channel is so low

in a downstream direction. It runs brown because the lowland is veneered with ancient mud from earlier and larger versions of Lake Champlain, because: the runoff has been enhanced by the forest clearing for agricultural use; cultivating the soil for seed crops exposes the soil to sheet wash; and the low gradient of the stream causes the channel to migrate back and forth against its muddy banks. I suspect that as the sediment load of the Lemon Fair River diminishes, the water will pass through a stage when it runs yellow, the color of rust-stained fine clay.

Lake Champlain

We crossed Lake Champlain, the largest lake in New England, on the bridge between Chimney Point, VT and Crown Point, NY.

Lake Champlain at Chimney Point Bridge.

As always, the lake is stunningly beautiful, especially at a distance, even if it resembles an oversized torn ribbon. Up close, it lacks the clarity of the rocky lakes we left behind such as Lake Sebago in Maine. This slight murkiness is due, in part, to the input of mud from places like the Lemon Fair River, which takes a long time to settle. But it's also due to higher levels of nutrient in the water, especially phosphorus and nitrogen, which leaches from many sources, especially from faulty septic tanks along the shore.

Also, near the shore were floating mats of Eurasian milfoil, a wildly successful invasive plant that is wreaking havoc on the aquatic ecology of lakes all over the world. Actually on the shore was a berm (low ridge) of fresh milfoil that had washed ashore in a recent storm. When the rain clouds leave and the daytime temperatures rise, this plant debris will rot to fill the air for miles around with a slightly fishy, manure-like aroma.

Non-literary fishing at Chimney Point, Vermont.

Just inland from the shore on the Vermont side was a campground full of oversized trailers, many attached to beefy pickup trucks. On that campground was an excavated artificial pond about the size of a two-car garage. Standing next to the pond were two oversized men and one oversized boy. They were fishing, with their backs to a body of water that has inspired great discoveries, art, and literature. Why? Were they afraid of the American sister of the Loch Ness Monster, who is rumored to exist?

They shouldn't be. That rumor was solved a few years ago when scientists correlated the alleged sightings with the periodicity of seiche waves (stationary oscillations caused by the sloshing of water) that raise and lower the water level a foot or so. These up and down movements were just enough to raise and lower a submerged log that -- in the hazy distance – resembled the shape of the more famous plesiosaur-mimic from one of Scotland's largest lakes.

Adirondacks

Leaving Crown Point, we fish-hooked south from the point, then west, then back north again along the lake on New York Route 9, passing through Fort Henry, site of the nation's first blast furnace. Soon we were in Newport, though not the one known for its yacht races and annual Jazz Festival. The west side of the lake is nearly one continuous cliff, a remarkable contrast to that of Vermont.

At Newport we turned west to climb the Adirondacks, the most rugged, though not the highest peaks in the northeastern United States.

Natural rock outcrop near Elizabethtown, Adirondacks.

This out-of-place group of mountains amazes me whenever I have a chance to visit them. Though so close to New England geographically, this group stands apart, sharing more with the Black Hills of South Dakota in terms of topography. As with much of the western Cordillera, the New England Appalachians is an elongated chain formed in the root of a fairly normal mountain range produced b the pressure of colliding continents. In contrast, South Dakota's Black Hills and the Adirondacks are odd, oval-shaped, anomalous uplifts that have raised much older rocks to the surface. As the Adirondacks rose, the valleys created a radial pattern, draining outward and away in all directions. This was later modified by ice-sheet glaciations, which excavated the lakes and blocked some of the northern drainages, diverting them to the south.

Arriving at Lake Placid, I was struck by the juxtapositions. As we pulled in on Route 86, we beheld an amazing concentration of horses being ridden by people with black boots and hats and jumping over various obstacles. I was surprised to discover that Lake Placid is "home to two of the nation's most prestigious equine masterpieces - the Lake Placid and I Love New York Horse Shows" (a quote from the home page).

Horse Show on July 3, 2009 at Lake Placid, New York.

That's fine. I like horses too. But where does the manure go, especially when it rains every day, as it has this last month?

Research is so simple these days. I simply googled "horse manure phosphorus excretion" and my first hit was a 2004 article by scientists from Auburn University involving a study of "eight yearling geldings (*Equus caballus*) fed four typical diets."

The good news is that the manure drains away from the lake. Another piece of good news from the study is that changing a horse's diet can affect how much pollution there is. The bad news is that horse manure contains a crap-load of phosphorous, which is the number one cause of making lakes murky. More specifically, the average horse excretes 3.0, 3.9, 5.3, and a whopping 7.9 grams of water soluble phosphorous for "diets containing whole oats, alfalfa cubes, sweet feed and pelleted concentrate," respectively.

Due to ongoing technical difficulties, I had to post my blog from the lovely public library, located in downtown Lake Placid. There, I noticed a pair of front-page stories for the *Adirondack Daily Enterprise* of Friday June 26 and Monday June 29, 2009. The first confirmed the arrival of invasive milfoil in the lake, despite years of effort to prevent this unwanted plant. The second, only three days later, reported that the problem was far worse than suspected.

Looking up from the papers, I saw a thoroughly relaxed guy, probably in his mid 60s, reading a book and enjoying the beautiful view of the lake seen from the reading room. When Kristine was speed-editing my blog, I introduced myself to William; he consented to answer a few questions. He lives on the beach in Santa Monica, California, and was in Lake Placid to visit an old friend for a week. He was there reading because he preferred that to playing golf with his friends, a man after my own heart. To my double-barreled water question (experiences or issues involving freshwater), he returned a double-barreled answer. He said that when swimming in the ocean, one must spit out the water that gets into your mouth, whereas in Lake Placid, you can just drink it down. My first thought was of the horse manure a few miles upstream.

His second response was that he found it interesting that the water temperature of Lake Placid was nearly identical to that of the Pacific Ocean in California, which ranges from the high fifties to the high sixties. This made me think about the complexity of water temperature variations in northern freshwater lakes relative to the much larger thermal mass of the ocean. Lakes here freeze in the winter and mix twice a year at a critical temperature of 39 degrees Fahrenheit.

West of Saranac Lake, the physical and cultural landscape changes dramatically. It's less rugged but more remote, and the towns seem more worn out and tired. Even some of the forests are sick, their reddish wood exposed where the bark has fallen off. Though I didn't have time to research this, I suspect one or more species of bark beetle are involved. They stand sadly above the beauty of the purple lupines, whose dark lavender color can perk up any gray day.

The town of Tupper Lake held a mystery. On its eastern edge is an enormous white building with hundreds of very strong metal-framed windows that I initially mistook for a grand hotel. It presides over a campus of white buildings, some of which are surrounded by fences over fifteen feet high that seemed impossible to climb. There is no name on the complex, and only a wooden sign giving traffic directions for the RBTI, whatever that is. Though this is by far the largest facility in Tupper Lake, there isn't a hint of what it is on the town's home page. Perhaps it's best to leave this a mystery.

Cranberry lake came and went in the pouring rain. To take a photo, I had to use my coat as a tent.

Cranberry Lake, Adirondacks New York.

Just to the west was Star Lake, which is far more beautiful than the town of the same name. It's an old mining town that seems to have fallen on hard times, given the number of empty buildings and falling-down structures. The Internet says they mined iron at Benson's Mines. My atlas locates many mining dumps, which have no doubt changed the chemistry of the streams. The biggest building we saw had railroad tracks running in one side and out the other, though no trains were in sight.

The town of Natural Bride came and went. Carthage came and went as well, all in the heavy rain.

Way Cool Watertown

We headed Watertown, New York, because we couldn't think of a more aptly named place to interview people on a fresh water journey. Just north of town we found the "Way Cool," ice cream stand. There, I got a junior-sized peanut butter chunk frozen yogurt to eat in the rain. Eating it gave me an affinity with those who I wanted to interview,

Way Cool Ice Cream Stand, Watertown, New York.

Pat and Tara were about my age, were eating adult-sized cones while sitting in a shiny red pickup. I started with an easy question. "Do you know how Watertown got its name," I asked. "No," said Pat. "No," said Tara between licks. Pat then added, "and I've lived in Watertown my whole life." Next, I moved on to my tougher double-edged question about positive experiences and concerns. Both times, they spent a few seconds thinking before answering "No." I guess they had neither an interest in, nor issues with, freshwater.

Josh and Amanda were sitting nearby in a dark blue Chevette, also licking large cones. They rolled down the window to inform me that they too had no idea how Watertown got its name. Knowing I was actually in the adjacent town of Black River, I asked them if they knew how it was named. Josh said "no," while Amanda said, "after the Black River," which runs through it. Of course, my next question was if she knew the source of the name Black River. No. Thoughts or concerns about freshwater? No. I got the distinct impression they were not trying to avoid me. They just didn't seem to care.

At the gas station were two Watertown locals. Neither knew nor cared how the city got its name.

Then it dawned on me. Perhaps our nation has the serious water issues it does because many, if not most of the voters are simply clueless about it. They can be both intelligent and educated, and still not care.

Gananoque

Historically, the Saint Lawrence River is probably the most important river in North America, the gateway to New France, then later to the heart of British Canada.

Landon's Bay on the Ontario Side of the Saint Lawrence River in the Thousand Islands area.

We crossed into Ontario at the Thousand Islands point of entry to arrive in Gananoque, where we spent the night of July 2. This date fell between the Canadian (July 1) and U.S. (July 4) Independence Day celebrations. Concerned that I might not find a place to stay, I booked a night at a chain motel, our case the Comfort Inn. We found it in the bull's eye of an exit ramp strip so typical of places designed for driving, eating, and sleeping. Near us on the strip were the Ramada, Holiday Inn Express, Howard Johnson's, familiar fast food and family restaurants, and a mini-golf course. It looked like any other exit ramp in the world.

A small piece of the exit ramp culture just inside the gate of Gananoque, Ontario.

The name of the city is pronounced "Gaahn ah knock' quay." There, we found the first of many fish statues to come.

The muskie is rusty in Gananoque, Ontario.

This enormous statue portrays the largest game fish of the region, the Muskellunge in a fighting mood.

Day 6 – Southwest on the 401 to Ingersoll (Ontario)

We got a late start, having stayed until after noon, writing editing and posting. Our plan was to follow “the 401” a four-lane expressway that traces a straight line through Ontario between the Canadian capital of Ottawa and Toronto, the nation’s largest city, before. From there, it continues in a beeline line to the U.S. border at Windsor, the sister city of Detroit.

The straightness is no accident. In sequence, the road parallels the upper St. Lawrence River, the straight northern shore of Lake Ontario, and the straight northern shore of Lake Erie. All are aligned by an ancient rift in the crust where a former billion-year-old mountain range called the Grenville meets the two-billion-year range called the Penokian.

Carbon Cycle

Very few lakes, streams, and ponds were visible from the road. Instead, we were treated to countless views of road cuts into what geologists call the "platform." This term refers to that stable part of the continent where ancient, highly deformed and fully cooked basement rocks measuring billions of years old are draped by generally flat-lying sedimentary rocks less than half a billion years old. We saw mostly layers of limestone, sandstone, and shale rising and falling above and below the ditches until they disappeared beneath glacial deposits.

The strongest and most prominent layers are made of a hardened version of limestone called dolomite. One thick stratum of this rock called the Niagara Dolomite is strong enough to hold up as a north-facing escarpment several hundred feet high extending from New York State to Wisconsin. The majestic Niagara Falls occurs where the Niagara River, which carries the north-flowing drainage of Lake Erie, falls off the edge of the escarpment and plunges down to erode the softer rocks below the level of Lake Ontario. If and when the falls migrates back far enough, Lake Erie will shrink to a fraction of its present size. Conceivably, one by one of the Great Lakes could fall to the level of the sea.

Slab of dolomite from the platform north of Lake Erie. This specimen was between Port Bruce and Port Stanley.

Dolomte is a carbonate containing magnesium in addition to calcium. A carbonate is any common mineral containing carbon and oxygen, both of which were extracted from the atmosphere. Such rocks are an important, and largely overlooked part of the earth's carbon cycle.

The vast majority of earth's carbon exists not in the atmosphere, where we worry about it today, but in two kinds of sedimentary rocks. Most familiar are those containing organic matter such as coal, oil shale, tar sands, petroleum, and natural gas, which we burn as fossil fuels. Combustion returns this ancient carbon back to the atmosphere as carbon dioxide, a greenhouse gas. Even more abundant than fossil fuels are lime-rich rocks, most of which were precipitated in the sea by marine plankton, reef organisms like corals and sponges, and shells such as oysters and clams. These lime rich rocks are the ones we saw for hundreds of kilometers (that's how they measure road distance in Canada) along our route.

When lime-rich rocks occur near the surface and soaked by the water cycle, they dissolve back into carbon dioxide and elements like calcium, magnesium, sodium, potassium, manganese, and iron. Most of this action takes place within the dark brown topsoil, where thin films of water cling to mineral particles and plant remains being decomposed by oxygen-loving bacteria. These microbes release carbon dioxide which, when dissolved in soil water, forms carbonic acid, the main agent responsible for the chemical weathering. The dissolved by-products of this process are what make water "hard."

Groundwater Concerns

Countless farms border the edge of Route 401 through the small cities of Kingston, Belleville, Oshawa, Toronto, Kichner, London, Chatham and Windsor, which are arranged like dots in an evenly spaced row The farms are here because the local bedrock combined with the rainfall regime provides the dissolved minerals needed for agricultural plants.

Under natural conditions, soaking rains and snowmelt flush some of this mineral-rich water downward to the groundwater table. There it gets even harder as it travels through pore spaces in sand and gravel, and fractures within rock.

Having skipped breakfast and lunch, we made an early afternoon stop in Belleville for a sandwich. The only choice was Subway. We pulled in behind a kids group, probably a summer camp of some sort. Luckily, I stood in line behind a couple willing to talk about water with a stranger: Jason, a husky, no-nonsense type of guy in his late 20s, and Irene, his wife, who works in the health care field. Her big concern was water contamination, especially for their child, who is now a toddler.

Water tanks and reverse osmosis purifier are commonly sold throughout this area. This example is from the Water Depot, in Woodstock, Ontario.

During the first seven months, this baby only bottled water that had been boiled as an extra precaution. Jason main concern was his observation that the area has an unusually high incidence of prostate, bowel, and testicular cancers. He's especially concerned about his father, who refuses to drink anything but tap water, reluctant to pay good money for that which flows freely from the tap and is free for the taking.

The water is indeed free of charge, at least after taxes. But so are the naturally dissolved minerals and pollutants that come with it. Jason has had their water tested. It's got a hardness of about 25 milligrams per liter, which fairly high, is high in iron and low in sulfur

Arsenic and radon are the only natural carcinogens that would likely find their way into the groundwater system are around here, and only as local anomalies. Every other contaminant likely comes from synthetic chemicals applied to the land for agriculture or the wood products industry. In open forest and farm country such as this, the main culprits are fertilizers, pesticides, and herbicides sprayed to maximize productivity. The list of chemicals and product brand names is a long one.

People here in inland Ontario are getting scared because they know they are vulnerable. Though surrounded by Great Lakes, this is a land of generally flat landscapes, very few natural ponds, even fewer lakes, no deep valleys and only small rivers. The only widely available source of potable water large enough for municipalities comes from fractured-rock aquifers reached by rock drilling. And unfortunately, most of this groundwater was recharged by rain and snowmelt that passed downward through the soils of chemically tainted farms. Jason has sprayed chemicals on fields himself when he worked the family farm. He is also suspicious of water companies, which he thinks might be making millions by exploiting people's fears. When waiting in the sandwich line in Bellville, Ontario, I talked with a twenty-something family so concerned about groundwater pollution that they gave their newborn nothing but boiled bottled water for the first year of the child's life.

Water Depot

When people dip water out of a stream or a pond, they have a pretty good idea of where it comes from. Ground water is different. For most people, its source is a mystery, one that contributes to their anxiety about pollution.

Having survived the stop-and-go traffic around Toronto, we decided to exit and travel the last 30 miles (45 kilometers here) to our evening destination on a back road. The exit sent me into a spiral ending in a stop sign for Route 15, which was not on my map. There was no sign for Route 2, which is there I thought I was. After being lost for a while, I pulled off the road to inquire at a gas station about my location. Behind me was a store called the Water Depot, so I went there instead.

One of 21 franchises of this clean-water retailer, based out of Barrie, Ontario.

I must have been fated to meet its owners, Gary & Jeannette Rebry, who posed for pictures, offered us a tour, and referred us to the place we ended up staying.

Gary and Jeanette, owners of the Woodstock franchise of Water Depot.

The Water Depot is a commercial franchise, no different in business model from most chain motels and restaurants. The originator of this water company, located in Barrie, Ontario, may have been the millionaire Jason talked about, the one who had been a farmer before deciding to sell water from his farm instead. According to Gary, there are twenty one Water Depot franchises, most of which supply water to the Toronto area. His main source of income is the steady stream of customers who arrive with one or more empty five-gallon jugs and leave with full ones. Though the price varies, it's now slightly less than $3 a jug, with discounts for frequent fillers.

People buy water for many reasons. Some like the taste, some prefer the way soap works with soft water, some are allergic to chlorine, some have cardiac or diabetic issues involving their sodium and salt balance, and some go simply to visit with two of the most

helpful and friendly folks I've met so far on my trip. But the reason most customers go is because they are afraid. They don't trust city water.

The water Gary and Jeanette sell has been on quite a journey even before reaching their retail store. It begins with precipitation either soaking through the "coffee filter" of agricultural soil, or running off in lazy streams that are generally avoided as water supplies except for livestock and irrigation because they are polluted by chemicals and fecal bacteria. Next, the water moves downward, picking up chemical contaminants and dissolved minerals on the way. When that water reaches the saturated zone, it moves generally sideways through rock fractures, picking up more dissolved minerals and possibly other contaminants from landfill leachate, malfunctioning septic systems, and leaking fuel tanks. Zones where rock fractures are large, common and well-integrated are the preferred target sites for water-supply wells. Finally, the city of Woodstock pumps that water up from the aquifers, tests it to make sure it isn't toxic, treats it with a small dose of chlorine to prevent bacterial contamination, and mechanically distributes it through pipes to homes and businesses.

Every customer, including the Water Depot, is supplied from the same treated tap water. What Gary and Jeanette do to improve it is test the water twice a day, take out the chlorine that the city put in, soften it by taking out excess dissolved minerals, and perform reverse osmosis to take out any remaining contaminants.

The customers can buy their own equipment at the store if they want, but most prefer to avoid the capital expense.

Remember Poland Spring in Maine, which we explored on the first day of this road trip? The water at their original "source," may indeed be better than what the tap water the City of Woodstock supplies its residents. But the business model of the Water Depot so much friendlier with respect to social and environmental consequences.

Poland Spring water is little more than a trademark-protected historic label for what is otherwise normal aquifer water sold by a multi-national corporation in disposable plastic bottles that are shipped by petroleum-burning, exhaust-emitting trucks. Water Depot, on the other hand, is owned by a nice, Chamber-of-Commerce-type couple that lives and work in the community they serve. The same is true for the whole company, which serves only the Province of Ontario, and is thus more accountable to provincial, as well as marketplace incentives.

The House that Cheese Built

Just before leaving, Jeannette helped me find the phone number for the Elm Hurst Inn in nearby Ingersoll. We decided to spend the night there. It's a converted Victorian mansion, built by James Harris, who pioneered the large scale commercial manufacturing

of cheese in Ontario. Cheese, of course, comes from milk, which is mostly water. This became quite clear near the end of our trip, when driving through the prairie, where watering is the biggest problem with their management.

The Elm Hurst Inn, Ingersoll, Ontario, the house that cheese built.

Our waitress at dinner, Erin was remarkably informed about local water. She's an Honors Chemistry major at Western Ontario University in nearby Kitchner. Her water story involved an Ohio-based mining company, whose blasting and pumping at a local limestone quarry has – she believed -- permanently changed the local groundwater flow regime. Farmers who used to pump water from their own wells must now hook up to expensive public sources. Details about the Carmeuse Corporation's activities in Dutton County, Ontario have been extensively reported in the local newspaper, the *London Free Press*.

I asked her for an up and down side to fresh water. When she answered, I realized a pattern had developed. Concerns about water usually popped into their heads faster than the positive experiences. Erin is worried that the levels of the Great Lakes had been low for about fifteen years and would stay that way forever, compromising existing shoreline facilities. We had not yet seen one on our trip, but would do so the next day. Her happy thoughts about fresh water were memories of being a teenager and swimming in an abandoned quarry. "The water was purple," she said, "probably because of the bacteria."

Her comment reminded me of a seldom known fact about freshwater. Across the continent, teenagers are drawn to abandoned quarries because they can congregate alone without fear of intrusion. It also made me wonder about the veracity of the information I was getting, for I have yet to see purple water in nature.

Statue from Elm Hurst Inn, Ingersoll, Ontario.

Marble, used for carving statues, is composed of calcium carbonate, the same stuff from the rocks of roadside southern Ontario are made. Material scientists are getting so good at fake marble that they use plastic instead.

What a lovely place to stay.

Day 7 – Lake Erie, a Wannabe Sea

For the first time on our journey, we stayed put for two nights in the same place. We figured that today, being the Fourth of July, would be a lousy day to travel in the nearby United States. Based on the traffic we saw the next day, this turned out to be prudent thinking idea. This also allowed us to experience Linda's breakfast twice.

Before leaving, I met a lovely old gentleman named Pete who helped keep the place in repair. He doesn't like the taste and feel of the water here, which is treated with a water softener because the customers like this kind better. He prefers the taste and feel of Woodstock hard water, the same fluid being delivered to the Water Depot before it's treated. Of course, if you want really hard water, I suggest you try ice.

Our upcoming day trip was through the farms, glacial lake plains, and the watershed draining into the north shore of Lake Erie. We would skip the other main group of tourist attractions around here that involve the Underground Railroad, on which slaves from the United States escaped to freedom before emancipation. Canadians are proud of this heritage. Ontario reaches as far south as Cape Cod and northern California. During the Civil War era, it became a peninsula of freedom extending south of Detroit. That this part of Ontario is not one of the U.S. states is an accident of history, both during the glacial phase and the era of exploration.

Georgia Bay, to the east of Lake Huron, is large enough and isolated enough to be considered a Great Lake in its own right. It extends southeasterly to an isthmus northwest of Lake Ontario that likes below much of upstate New York and is less than a hundred miles wide well below the latitude of Ottawa. This neck of land contains the enormous Lake Simcoe and dozens of other glacially gashed bedrock lakes, now connected by the Trent Canal system. Had the ice sheet dug down just a little harder, these lakes would have coalesced to join Lake Ontario with Georgia Bay, forming a single Great Lake. This would have connected the prong of southern Ontario to Michigan and New York by narrow land bridges across which the Detroit and Niagara Rivers now flow.

A Not So Green Revolution

The trend these days to "go green." While thinking environmentally is the certainly the right way to go, using this color to signify correct thinking is a blatant example of color chauvinism. A green polar bear would be a dead polar bear, and the Grand Canyon wouldn't be grand had it been continuously covered with foliage.

This is Mennonite country. This Anabaptist sect eschews modern amenities such as the gasoline-fired equipment used for the mechanical baling of hay. We found this out while driving south to Lake Erie, passing by a field being hayed by hand. Two horse-drawn teams were the involved, both of which were driven by pre-teenage boys. The first pulled a mechanical rake that swept the hay into rows. The second was a conveyor belt that brought hay up to a wagon where it could be forked into a stack. That hay will feed the cattle, which will give milk and meat to keep the sect going.

Haying the old fashioned way, Oxford County, Ontario.

One small boy, who couldn't have been more than about ten years old, was driving the horse-drawn cutter ahead. Another was driving the team pulling the hay wagon. Loading the hay, however, was man's work. His job was to take the hay being brought up by a conveyor at the back of the wagon, stab it with a pitch fork, and lift it over his head and toward the front of the wagon. I him do this a least a hundred times, which constitutes quite a workout. It made me wonder how many Americans his age were pumping iron in the gym for no net gain as their children were stuck in front of their video games.

The traditional farm was surrounded on all sides by commercial export farms, growing mostly corn, wheat, and soybeans. I love this country, probably because it resembles some of my earliest memories on our family farm in North Dakota, where we grew wheat, barley and flax, in that order, at least in the late 1960s when I worked there as a farmhand, pitching hay with a fork by hand, but doing so with bales, rather than loose hay. Each farm both here and in my youth, had a silo, various outbuildings, and a

farmhouse.

The country is slightly rolling and ideal for farming because it occupies a till plain. Till is the stuff that was pasted, lodged, and smeared at the base of the ice sheet as it glided over the land. When, as in this case, the ice sheet passed over fairly soft sedimentary rocks of the platform, the till is a mixture of sand, loam and clay that holds water well, and easily yields to plants the minerals they need. Where there's too much water, however, it does contribute to runoff because it was so compacted by the weight of the ice.

Field of corn on slightly rolling topography of the till plain between London, Ontario and Lake Erie.

Yesterday, when groundwater was the focus, the main issue was contamination. Here, on less permeable soils, the main water issue is nutrient pollution from agricultural runoff, though not once was this mentioned during my frequent open-ended inquiries about water joys and concerns. The streams here have serious problems. Below is a tributary, the name of which I don't know because my good maps cover only the U.S. It was typical of three or four we saw from the car window.

The color is not pea green, which has a milky background, but a slightly iridescent dark green diminished in intensity by dilution with otherwise clear water. The green is the color of algae, growing happily in the surface water because they have everything they need to thrive. What normally checks the growth of algae is a shortage of nutrient, more specifically water soluble nitrogen and phosphorus. These are exactly the elements applied to farm fields as fertilizer to make the crops grow. Basically, any nutrient that runs off the farm is freely available to algae, which, in flowing streams, grown in proportion to the amount that's available.

Larger, visible aquatic plants (called macrophytes) follow the same rule as the algae. Their growth is stunted by limited nutrient. They flourish when it is widely available. Quite obviously, both the algae and macrophytes are thriving in the stream below, immune to whatever other invisible pollutants are there as well.

Stream polluted with excess nutrient from agricultural runoff, Oxford County, Ontario.

The flow is from bottom to top, the photo taken from a typical roadside bridge, and the true color of water is brownish green. This kind of pollution is called eutrophication. Some nutrient is necessary for stream and lake life. But too much can be deadly, leading to the darkening of water with excess algal growth, the choking of water ways by excess growth, and, in the worst cases, the growth of blue green algae that foster bacterial toxins, a classic case of having too much of a good thing.

No fly fisherman, kayaker, or canoeist would go anywhere near such a stream. And where is it heading? Lake Erie, the "poster child" for air-stinking, fish-killing, lake-fly snowing eutrophication that I recall from the late 1960s and early 1970s when the U.S. government was negotiating the Clean Water Act. One of Richard Nixon's first acts as president was to sign NEPA, the National Environmental Policy Act on January 1, 1970.

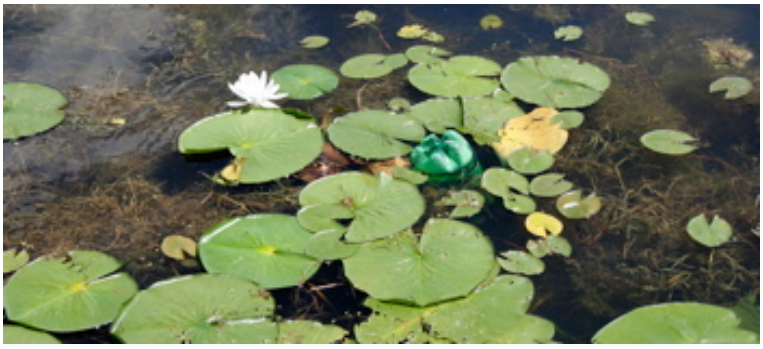
Lake Whittaker

Linda suggested that I visit Lake Whittaker on my way to the Erie shore.

Lake Whittaker in Alymer, Ontario.

Initially, I couldn't figure out what a lake was doing here in country so conspicuously absent of lakes. Nor could I figure out why the sign out front said “Kettle Creek Conservation Area.” It turns out that this was originally a small pond or marsh near the headwaters of Kettle Creek before the water level was raised with a dam to create a recreational lake. Dozens of kids were happily swimming and canoeing. The creek enlarges below the dam to become a fairly large stream flowing to Lake Erie, which enters at Port Stanley.

A pond practically anywhere else in this agricultural watershed area would be seriously eutrophic, due to farm fertilizer runoff. As it turned out, Lake Whittaker was only moderately green and only half-choked with aquatic weeds because it lay at the highest point of the headwaters. Only by tucking the place in the headwaters would it stay fresh enough to attract those who pay for year-round camping spots or a daily entry fee of seven dollars. This is a captive market for those who want to swim outdoors, but not in Lake Erie to the south.



Unusual green flower (upside down soda bottle) on lily pads in Lake Whittaker, Ontario.

Pool Table Flat

At Aylmer, there was a slight downward dip on the landscape to perfectly level ground. Even the slight undulations of the till plain were gone. Surely, I thought, we had entered the domain of the "lesser than" lakes. This is my teaser to folks that think the Great Lakes are great, which they surely are. From my point of view as a geologist, however, they far less great than they used to be. When the ice sheet was retreating northward, the outlet for all of the Great Lakes, the Saint Lawrence River, was blocked by the great mound of ice. The basins now occupied by the Great Lakes were then occupied by even larger lakes, the shorelines of which were controlled by the elevation of outlets draining southward into the Missouri, Mississippi, and Ohio River watersheds.

Meanwhile, the glaciers were grinding away on the Canadian Shield, producing gigatons of grit (clay and silt-sized particles) per year, and were being drained by meltwater streams, which washed that grit out into the lakes. These "Greater" Great Lakes never clarified completely because the meltwater flow continued all year at the base of the mile-thick glacier, due to geothermal heat. But most of the sediment did reach the bottom, draping the landscape beneath a thick sheet of winter ice with silt and clay in staggering quantities. That's what Kristine and I were driving over, the former bottom of a muddy glacial lake, which is pool table flat at the scale of miles.

Flat landscape of a former lake bottom between Port Bruce and Port Stanley, Ontario.

The edge of this flat landscape was eroded back by Lake Erie, to produce a series of brown bluffs that can be seen from the beaches and piers, and especially from boats. Why are they brown instead of gray?

When the lakes drained, their former muddy bottoms were exposed to the air. Infiltrating water rich in oxygen trickled through the soil, rusting its iron-rich minerals to that beautiful light-brown color. That rusted soil washes off the farms and enters every stream draining into Lake Erie from the north, turning them a beautiful shade of brown like that of coffee or tea into which milk was poured. They are "latte" streams.

Catfish Creek near its confluence with Lake Erie at Port Bruce, Ontario.

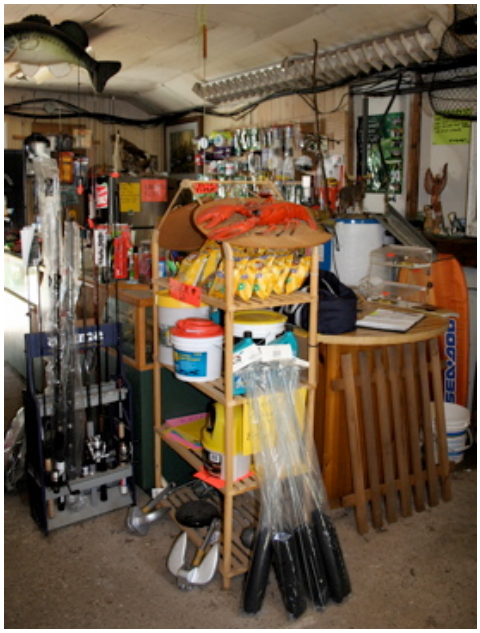
This is the normal color of the stream, due to the suspension of tiny clay- and silt-sized mineral stained by "goethite," a.k.a. limonite, a.k.a. rust. An unnaturally high concentration of sediment is considered a form of sediment pollution, though the presence of sediment itself is not. The same is true with nutrient. It's a pollutant only when in excess.

Fishing Lake Erie

The door was open, so I walked right in to Ron's Bait and Tackle Shop in Port Bruce, Ontario.

Ron Shelley standing in front of his bait and tackle shop, Port Bruce, Ontario.

His place was adorned with a lifetime of memories of fishing and hunting trips, preserved in perpetuity by taxidermy. I refer to a thicket of antlers mounted on wall plaques and a few dead fish trapped forever in real-life poses. What caught my eye was a plastic lobster, no doubt placed there for a joke. No crayfish ever got that big, or that red. Of course, everyone from New England, where they are caught, knows that lobsters become red only after you cook them.



Inside of Ron's bait shop with plastic "Lake Erie" lobster.

Nobody came, so I took the time to photograph and transcribe the text for a bait product being sold right in front of cash counter, as if it were candy in the aisle of a grocery store. Made by Berkley, the text on the cover reads:

GULP ! ALIVE
Looks Alive, Feels Alive, Tastes Alive.
Il semble vivant. Il sentle poisson vivant. Il goute le poisson vivant.
3" 8 cm Leech
Black
Re CHARGE Baits
with Gulp Alive

Next to Gulp Alive on the counter was a tank of live leeches. If I recall correctly, they were about $5 per dozen. Why, on earth, I wondered would he sell both? Surely, the presence of live leeches would indicate that the fake one's aren't a good for bait. Ron's bestselling bait is minnows, Emerald Shiners.

On the other hand, there might be people who would touch a fake leech but not a real one. Perhaps people like these children, who were proud to show me the yellow perch they've caught so far from the Port Bruce pier.

Girls fishing for perch, Port Bruce, Ontario.

Perch like these, according to Ron, are the main reason people come here. The legal limit is 50 per day. They're mighty good tasting too, and totally safe, based on testing for chemical contaminants. Ron had just finished cleaning a dozen or so and put them on ice before I arrived. There he was, with a cold beer in his hand being kept cool by an insulated sleeve as tight as a wet suit on a scuba diver. Recreational fishermen also go

after pickerel, stocked rainbows, and in the muddy creek, catfish. It was the presence of rainbows that surprised me. Typically, they are present only in very clean, low-nutrient water.

Indeed, Lake Erie has "cleaned itself up," least according to Ron, who believes the Zebra mussels are responsible. He's happy they are here. Practically everyone else I know is, or at least was, concerned about his invasive species, which has greatly changed the aquatic ecology of many water bodies. I'll leave this debate for later.

Freshwater Seascapes

The sandy north shore of Lake Erie has everything that a seascape has. You can sense the immensity of the water because it's impossible -- even if you try very hard -- to see across the water. You can see and hear the waves, the adolescents playing Frisbee, and the children building sand castles, and the over-fifty crowd walking and talking. But everything else is scaled down.

Lake Erie Shoreline at Port Bruce, Ontario.

Milky aqua-blue water is visible beyond the zone of shore-hugging, latte-colored water brought here by Catfish Creek, Beyond that is aqua blue, and even further out is dark blue. It has only a trace of suspended clay and algae.

Relative to the ocean, the piers and lighthouses are scaled down. In size and shape the one at the pier in Port Bruce resembled in many galvanized steel road culverts I've seen, but stood on end.

Roderick, the father with a T-shirt, is fishing with his wife and two girls, who are seated in chairs. They came from nearby Tilsonbury. He confirmed that the best thing about freshwater was family fun on the shores of Lake Erie. His main concern is the GTA, short for Greater Toronto Area, which be believes will soon overrun this rural landscape, and compromise its water resources.

The housing is scaled down too, at least here in Port Bruce. It's a good thing that this area hooked up to sewers (or at least some other form of wastewater treatment facility). Within a hundred yards of the beach is the most amazing concentration of "cheek-to-jowl" campers I've ever seen. Most look like they haven't moved in years. The white one the left has two frame buildings attached to it, in contrast to the other campers who have only one apiece. I wonder what kind of zoning regulations create this sort of coastal ghetto.

Dense lakeside living at trailer campground, Port Bruce, Lake Erie, Ontario

Kristine asked me what the round things were? I almost remarked that they were Viking shields of the sort that decorated the edges of long boats. Actually, they were plywood, probably the ends of spools of wire or rope or something like that.

Drinking Lake Erie

On the drive between Port Bruce and Port Stanley we drove by an industrial-looking building with a sign out front, crumbling entry steps, and, for some reason, an exotic slab of imported stone placed at the entrance for architectural decoration. Perhaps the stone was there because this was otherwise a land of mud and sand. This was the facility of the American Water Canada Corporation, which sounds like an oxymoron to me.

Sign in front of Elgin Water Supply Complex, Port Stanley, Ontario.

When I was in college, Lake Erie was the poster lake for environmental contamination. Today, and notwithstanding its silty and nutrient-laden inflows, Lake Erie is now clean enough to drink, after treatment, of course.

Visitors to the Elgin Water Supply Complex had to sign in, and phone either the lunch room or the control room. A young woman picked up my call in the control room. Quickly, she transferred me to a young man because she said her shift was over. However, I wonder if she was concerned over what I might write about what she said.

The tentative approach of the young man confirmed my suspicion that they were not used to being interviewed by walk-ins. In fact, company rules explicitly forbade my entry beyond the glassed –in entry room and his exit from the main building during his shift. His compromise was to bisect his body with the doorway, the anterior half in the entry room with me, and the posterior half in the main building. I never learned his name. He preferred not to give it to a complete stranger with a black book in one hand, a business card in the other, and a camera around his neck.

Here's what I found out. One mile to the south is a water intake. Fifty thousand cubic meters per day are sucked into the building with enormous pumps, which filter, clarify, chlorinate, fluorinate, and test the water. Clarification is done with alum, the common name for aluminum sulfate, a harmless coagulant, because people want to drink clear, not milky water, regardless of its invisible chemistry. That volume is pumped uphill to approximately 100,ooo people, meaning that each gets an amount more than one square yard in area and about twenty inches high. Most of that is used for flushing and washing.

What I found ironic and amusing was that this very helpful guy knew only about the anterior end of the water business, meaning the supply side. The posterior side, meaning the wastewater effluent side (that's doubly ironic), is taken care of by someone else. I know this because when I asked him about wastewater he didn't know. The other thing I found amusing was his stories about the kinds of water the employees prefer. One brings his own bottled water into the facility, apparently avoiding what 100,000 people

get each day. My informant has a choice to drink tap water before or after flouride is added. He goes for the one without flouride, the opposite of what most dentists and politicians recommend.

Just before leaving, I asked him what the general public thinks about what they do. His answer was wonderfully informative. "It's like any utility," he said. “Nobody notices until it shuts down." Indeed, I take notice when my Internet shuts down, my water stops flowing, and my electricity goes dead. This happens to me during hurricanes and ice storms, the only water threats that impact me on my hilltop in southern New England.

That's why water towers are so cool. They're a form of insurance for when things go wrong. If the power goes down, and backup generators go down, at least we have a supply of water available, one that gravity alone can operate.

Water tower for Port Stanley, Ontario.

Hidden Connections

The mouth of Kettle Creek in Port Stanley is latte brown, the same color as Catfish Creek. There I met Jay and Lorie, who were about to get married, and Lori's parents, Mike and Sandra. Their wedding reception will be held, in the restaurant across the Creek, after the actual ceremony on the family farm, in a nearby town where Mike is the patriarch farmer and Sanda runs the house.

Perhaps Guy Lombardo started the tradition. He and his band played at the Stork Club, whenever they were in town, which apparently was quite often. Now it's gone. We must have heard this local claim to fame at least a dozen times.

Moored at the pier were what looked like fishing trawlers capable of storing and pulling large nets. I wondered if this was still going on in the lake? When I asked Mike if he knew what they were, for, his reply was "fishing boats." That was obviously not in his line of work. But it was one more reminder that the Great Lakes are freshwater oceans.

Large ocean-going ships used to come right up to the dock in Port Stanley to pick up grain from the now-defunct granaries, and to offload oil for heating to the now-defunct oil tanks. Mike told me that they couldn't do this now, owing to heavy sedimentation in the ship canal, where the latte-colored muddy water flows slowly enough to deposit the sediment. This makes me wonder if the rapid sedimentation is a historic phenomenon, perhaps post-dating the forest clearing for agriculture, one industry adversely impacting the other.

Wedding preparations in Port Stanley. Jay (the groom) standing with his fiancé Lorie and her parents, Mike and Sandra, Port Stanley, Ontario.

When prompted, Jay and Lorie said the best thing about freshwater was Lake Erie, which was very clean when compared with Lake Ontario. They were especially concerned about the Golden Horseshoe, the rim of heavily industrialized adjacent cities between Owasha (east of Toronto) and Saint Catherine's, near Niagara. There, the western edge of Lake Ontario is terribly polluted by all kinds of metals and synthetic organics, and no one swims in the beaches owing to E-coli outbreaks.

From there, we headed out to the Port Stanley beach, which contains many informal beach restaurants and is home of the allegedly world famous French fries at MacKay's. Perhaps the population of sea gulls has something to do with this fame

During the summer of 2009, I took a road trip to explore the freshwater resources of the northeastern and northcentral states. This blog -- written in the style of William Least Heat Moon's Blue Highways -- provides a day-by-day journal of this quirky trip, which explored the links betwen the physical and cultural landscapes.

Girl is chasing pizza-eating gulls away from a blanket that was left unattended.

Finally, we left for Ingersoll. Following the signs to the 401, we passed through Sheaden, which bills itself as the rhubarb capital of Ontario. Rhubarb, of course, is mostly water.

Day 8 – Michigan's Mitten

Sunshine at last! We woke to an absolutely beautiful summer morning, the first so far on our trip. To day, we would return to the U.S. at the Sarnia-Port Huron Crossing in order to explore both the thumb and hand of Michigan's mitten. The thumb refers to the small peninsula to the east between Saginaw Bay and Lake Huron. The "hand" is the much larger peninsula to the west between Saginaw Bay and Lake Michigan. The tip of the hand, where the middle finger would be, is Mackinaw City, where we had reserved a room for the night.

After a nice breakfast, I wandered around on the carefully landscaped grounds of the Elm Hurst Inn. The one landscaping problem they couldn't do anything about is the quality of the water, which runs brown with clay during flood.

Settled clay on the bottom of a clarified stream behind Elm Hurst Inn, Ingersoll, Ontario.

For clay to settle out in such a way requires that it be flocculated, which means that something in the water must cause the clay particles to stick to each other before settling. Usually, this is the presence of a mineral salt, most often sodium. Seeing this made me wonder what else was in the water.

Crossing Paths

While loading the car for departure, I noticed a car with Michigan plates being loaded by a couple Steve was wearing what we later realized was familiar Michigan attire, a John

Deere T-shirt, jeans, and a baseball cap. Jill, who could do a great imitation of Sarah Palin if she tried, wore nice, but non-descript traveling clothes. We were heading west from New England for a freshwater journey. They were headed east to New England for genealogy. I found it interesting that we crossed paths in the middle of Ontario.

I asked them if they had a favorite lake. With out hesitation, Steve answered "Superior," accompanied by a nod of agreement on Jill's behalf. I asked them if they had a least-favorite lake. "Huron," they said. "All of Huron?" I asked. "No," they said, "just all around Saginaw Bay." That's Michigan's answer to Wisconsin's Green Bay, an industrialized river valley in a geological basin that opens north-northeast on the eastern side of the state. When I inquired about why Huron was yucky, they replied: Dow Chemical, all the industry, especially GM or General Motors, Inc. Jill talked about how beautiful Bay City State Park used to be in the early 1980s, when she was a high school girl, and how weedy, discolored, and slimy the water has become since. I recalled an old high school girlfriend of mine, who moved to Bay City. She swam with me in the late sixties. Did her kids swim with Jills in the early 80s?

We left Ontario at the Port Huron border crossing, with Lake Huron to the north and Lake Erie to the south. My passport -- issued in Chile after I the original was stolen during a mugging – was expired. The Department of Homeland Security let me in anyway. Entering the U.S. gave me a chance to reflect on the people of Ontario. No one bad-mouthed the U.S. All were helpful. Yesterday's local newspaper from London documented a poll that showed more support for Barack Obama than for any national Canadian leader. I took this as an example of the grass always being greener on the other side of the fence.

We also looked back on the many misunderstandings and built-in contradictions we heard about fresh water from the Canadians. Removing gravel does not change the elevation of the water table. Stable rivers in hydrological equilibrium do not need dredging. Private water-treatment stores claim that what the city puts into water is bad, but proceed to elect politicians who put that stuff in the water. This sounds a lot like what we experience in the United States.

Artificial Kettles

I'm studying page 43 of my Delorme Atlas and Gazetteer for Michigan. Parallel to Interstate 69 and between exits 198 and 194 are nine small lakes, all within about six miles distance. I look up and spot one, then another, then another. There nice little ponds, now surrounded by trees. The one with a trailer park had two guys sitting in the shade, watching the highway, rather than what I would think is a nicer view out back. The one with stick-built homes had children playing in the yard.

These are artificial lakes, created by the excavation of gravel used for building the

interstate – probably in the 1960s or early 1970s -- and the shutting off of the large sump pumps that kept the growing depressions dry. In terms of family lake culture, such former quarries are analogous to personal pan pizzas, being smaller than one might hope for, but big enough to satisfy the need.

In terms of hydrology, these spring-fed ponds resemble small kettle ponds, depressions formed when a block of stagnant glacial ice was buried by meltwater sand and gravel before the ice disappeared. In terms of shape, however, the ones along the highway more closely resemble baking and, being rectangles, or in one case a triangle. I can hardly think of a better case sequential land-use development than gravel quarries turned into ponds.

The super-flat road near Imlay City was under construction. The dirt there was glued together in huge peels, indicating how clay rich it was. As was the case yesterday near Aylmer, we were crossing the floor of an expanded great lakes. In fact, at that time, the lakes were confluent.

With the landscape so flat, I began to study the map. In St. Clair County about 10 miles due west of Lakeport (on Lake Huron), was a lake with a most fascinating shape. Aside from a bulge on the southwest side, the lake was perfectly circular, as if a canal had been excavated back on itself. That's what I guessed it to be, a speedway dredged out for motor boats. Two nearby towns were named Fargo and Yale. Having visited both, I can hardly imagine two places being so different.

Fractal Network

The Water Resources Division of the U.S. Geological Survey does a wonderful job measuring the quality and quantity of flow of our nation's rivers and streams. They do this to identify long-term trends and to provide the data needed to predict floods and droughts. I noticed from my map that one of their gaging (measurement and sampling) was located on Farmer's Creek in La Peer, Michigan. We turned off Interstate 69 to investigate the first of several Michigan streams.

We stopped at a convenience store to get the name of an unlabeled road. The manager of the store had no idea what a gaging station was. His befuddlement reminded me not to make any assumptions about what people know or do not know about fresh water. He was able to give me directions, however: turn right after the gas pumps: go straight past McDonalds and Payless Shoes; turn right and pass the enormous Wall Mart and its parasitic stores and parking lots; head for the stream. We made the turns, just fine, but got swept up into a four lane divided highway that dumped us out onto a tiny county road, soon to become gravel. This was an overbuilt and unnecessary overbuild if I ever saw one.

We never found the stream gauge because of all the development. But I can tell you one thing for sure. If it were still operating, it would document four local trends that are well known from other settings in snow country where miles of exit ramp, strip-mall development have taken place. Stream runoff is flashier, meaning it's more prone to flooding, because the pavement and rooftops are completely impervious. Groundwater recharge is usually lower because the rainfall and snowmelt left as runoff, rather than infiltrate into what used to be pastures and fields. The quality of the water is greatly reduced, and in some cases toxic, because the residues of car exhaust and parking lot spills are quickly rinsed into streams. Finally, the hundreds of acres of roads and pavements require applications of salt and sand to melt ice and provide traction during the long winter. Everything, of course, washes into streams.

While traveling to the site of our failed search, I studied the map for its stream linkages. Our target stream, Farmer's creek, paid tribute to Mill Creek. That's where the term tributary comes from. In turn, Mill Creek paid tribute to the South Branch of the Flint River, then the merged Flint River, then the Shawassee River, and then finally the Saginaw River before entering Green Bay. Upstream of the gaging station, Farmer's Creek had two main branches, both of which originated in a concentration of small kettle lakes fed by springs.

This makes the Saginaw River a seventh-order stream, using the map that I had. The smallest tributaries are considered first order. When two first-order streams join, they form a second order and so forth down the line to the stream mouth in Saginaw Bay. This hierarchical pattern is typical of most stream systems. On glacial moraines however, the first link, the one not counted, is a lake or swamp. In lake country, kettles serve the streams, rather than the other way around.

Bronson Lake

Just south of Bronson Lake is a clue to what's wrong with so many lakes from Maine to Montana. Behind an otherwise nice house and well-kept barn was a small pond, which was probably impounded to water livestock perhaps a century ago. The water of that pond was hidden beneath a floating carpet of lime-green duckweed so thick that a songbird could have walked on water.

The light-colored material in the photo is not a sand trap. Instead, it is a coating of green duckweed covering a pond below a small feedlot, La Peer County, Michigan.

Duckweed is a tiny flowering plant about the size and shape of a small housefly. Botanically, it's an amazing and beautiful adaptation. However, their presence usually indicates a pond overloaded with nutrient, usually phosphorous and nitrogen in unusually high concentrations.

The source of that nutrient was crystal clear. Directly above the pond was a thoroughly trampled livestock pen with just a few cow-patties left undisturbed. It was a small feedlot, a place where cattle are confined in one place and where the food is brought to them, rather than let them wander a pasture in search of grass. Feedlots are more economically productive than pastures in terms of the amount of beef or milk produced per acre. But besides boring the cattle nearly to death, they also create a nasty sludge of potential nutrient pollution. If not diverted or treated, leachate responsible for turning many lakes green with algae or, in the worst case, duckweed. Americans eat lots of meat and expect not to pay dearly for it, creating marketplace incentives conducive to feedlots, rather than pastures. In this case, it is the lakes and streams that pay dearly.

The road hugging the edge of Bronson Lake isn't safe for people like us who don't know where they're going. The uphill side is a steep bank of gravel, typical of glacial kettles, especially small round ones such as this. The lakeside edge of the road was fenced, and with narrow shoulders. We finally found a place to pull out. The white pipe you see in the center of the photograph (below) ran directly beneath my feet to a white standpipe with a bright red cap.

Bronson Lake, near LaPeer, Michigan

When someone's house or barn is on fire and the fire truck needs water, they spin off the red cap, hook up a hose, and suck water out as if from a straw.

Small lakes across the entire Blue Galaxy provide us with community fire protection. They can save lives too. When great wildfires struck places as far apart in geography and culture as Hinkeley, Minnesota and Wellfleet, Massachusetts, residents were saved by wading into the water and waiting for the fires to burn out around them.

Within a few minutes were cruising by Holloway Lake, the water-supply reservoir for Flint, Michigan, an All American city where General Motors manufactured millions of cars before going bankrupt earlier this year. One would never have guessed that the region was in economic distress, based what I saw while driving along its southern shore. The sky was light blue with puffy clouds -- the water a clean dark blue. Countless motorized watercraft ranging from the floating patios called pontoons to self-propelled personal jets were on the water. Delighted kids were being towed on floating inflatable rafts of all size and shape. Adrenaline-loving jet skiers were sending up great white sprays. Water skiers were using the large wakes of boats as do snow skiers use moguls, to become temporarily airborne. I saw nothing powered by wind or muscle power, and nobody swimming. I suspect swimming is illegal, as it is in reservoirs where I live.

The shoreline was Exhibit A in the case against poor shoreline management. Banks eroded by waves were dispersing suspended mud into the water. Immaculate, and

therefore fertilized and herbicide-sprayed lawns ran right to the edge of the water. In some places, the shorelines were protected by boulders and vertical sheet pilings. Oversized houses were spread along the shore. The good news is that people were having fun. But at what cost?

Pleasing Petunias and Billboard Curiosities

We left the back country roads of LaPeer County for Michigan Route 15, heading north toward Saginaw. My AAA (American Automobile Association) Atlas lists this as a scenic road, which it certainly is in the small city of Vassar. Whoever planted the roadside petunias deserves a prize for community beautification. No doubt, some of the fertilizer probably escaped to the groundwater table, a trivial input compared to the lush green corn fields we had been driving through.

The cheerful gauntlet lined both sides of the road for more than half a mile. It began at lovely Hillside Park, within which was a small bandstand for the Vassar City Band, the kind that my father directed until he was in his mid 80s. The petunias ended where McDonalds inaugurated the local "strip." Across the street was a boarded up IGA. Americans don't cook as much as they used to. They eat out instead, often from their cars. But then again, this is Michigan, the auto state.

"A Manufactured Home Community." I saw that billboard in Millington, though I don't know what it means. Perhaps these folks are like those of a biker community that gels around a common theme. Then again, it could be a trailer park without the hitches for being towed.

While studying the map, Kristine spotted another interesting billboard. Its advertised Internet address was: http://www.spraymylawn.com/. I can only guess what that's about. I wonder if anyone bordering the Holloway Reservoir used its services. With amusement, I jotted down a more complete URL for the billboard: http://www.spraysomesyntheticchemicalsonmylawnabovealakenearyou.com/.

To skip the city of Saginaw, we jumped on to Interstate 75 and turned left on a nearly identical road, Michigan Route 10. The traffic was very light in our direction, which was north followed by west. In the other direction toward Flint, Detroit, and the "I" states to the south – Indiana, Illinois, Iowa – the traffic was bumper to bumper for miles. I hope those trapped in cars were thinking happy thoughts of the lakes they left behind. Practically all of the vehicles were American made, generally GM and Ford. For the first time on the trip I felt a little guilty, cruising around in a Volvo with Connecticut plates.

We crossed into county, speeding by Sanford Lake on Michigan Route 10. It resembled the Holloway Reservoir, with perfect lawns leading up to a sharp edge held in place by sheet piling.

Snow Snake Ski-Golf

At Claire, we headed north on Interstate 127. In Harrison, we took Exit 168 to explore a "Unique Natural Landmark," labeled "Glacial Moraine," on my gazetteer. Though definitely a moraine, it was hardly unique. Practically every hill in the mitten of Michigan is a moraine of some sort. With an endless supply of Canadian granite to the north and with enormous lobes of ice in the low spots (Erie Lobe, Saginaw Lobe, Lake Michigan Lobe), northern Michigan is festooned with a jumble of curved moraines, deposits of sand and gravel that washed out from beneath the ice and became concentrated in certain places.

The Snow Snake Resort occupies the north face of a moraine ridge that was originally about 180 feet high, before they raised it an additional 20 feet of fill to squeak the height over 200 feet.

Carved rock at entrance to Snow Snake Ski-Golf, Harrison, Michigan.

Being July, the chair lifts were empty. Instead, golfers were practicing their drives and fairway shots by hitting them against the ski slope.

Chair lifts at Snow Snake Ski-Golf, Harrison, Michigan.

Outside, I talked with a nice young man named Garret Greer. He's the skiing and snowboarding instructor during their short season from approximately Christmas to Valentines Day (if they are lucky). During the summer – we saw him drive up on a golf cart – he does "whatever he's told to do." When I asked him how many come from within a half hour drive, he said "about 90%" I'm guessing that population includes nobody from the Rocky Mountains.

I also talked with the inside manager, John Cleary, who runs the restaurant and store, a combination pro shop and ski shop. His water issue involves the potential state control of the groundwater resource in the Michigan interior. Located on a giant ridge of sand-gravel, the resort must get all of its water from the same stuff, but from below the water table. They use pumped water for irrigating fairways and greens in the summer, and for snowmaking in the winter. Already the resort is required to report its water usage to authorities. John mentioned that several bills have been introduced in the state legislature to do so, none of which have passed. On the positive side is Michigan's "cottage culture."

Quite literally, those who ski the western mountains of the U.S., which reach above ten thousand feet, look down on those who ski the New England Appalachians, which rise no higher than Denver but, nonetheless, have elevation drops measuring more two thousand feet. In turn, New Englanders look down on places like Snow Snake for its pitifully small 200 foot drop. In turn, Snow Snake looks down on Chicago's Mount Trashmore, a ski facility developed on a nearby abandoned landfill. This pecking order of skiing

confirms the first rule of real estate: Location, location, location means everything. Ninety percent of Snow Snake's customers are locals, coming within 35 miles.

What like most about Snow Snake is that it has everything to do with water. Frozen water the form of glacial ice brought the hill here. Frozen water in the form of snow brings the customers here. Liquid water, in the form of aquifers, brings them the water they need to operate.

Michigan's Largest Lake

Houghton Lake is the largest lake contained entirely within Michigan: the Great Lakes are shared with several other states and Canada. It borders on the "Dead Stream Swamp" within Au Sable State Forest. Along the lake's south shore are the municipalities of Houghton Heights and Houghton Lake.

Less than half a mile to the south is the regional sewage treatment plant, which drains toward lake, and which is currently in the process of being upgraded.

Sewage treatment plant for Houghton Lake, Michigan likes within a mile or so of the lake and drains toward it.

Whenever a sewage plant is under construction, this usually indicates a problem of some sort, even if only about limited capacity.

Practically every destination lake, even when completely surrounded by forest, experiences a viscous cycle of pollution. The lake brings in people, who bring in more people. Because only a limited amount of human wastewater can be handled by onsite septic systems, eventually the lake degrades in response to the increase in nutrient and bacterial pathogens. Next is the arrival of a sewage treatment plant, which allows more people to move in. Eventually, the capacity of the original plant is taxed, which sets the stage for a bigger plant, then, more people, and so forth. Chicago started this way as well.

Only when I reached the south shore of Houghton Lake, did I understand one of the billboards I had passed a few miles back. It advertised a company claiming to be the state's (if not the world's) largest dealer in pontoon boats.

Pontoon boat and jet skis at Houghton Lake, Michigan.

These are basically floating patios; platforms surrounded by guardrails that float above two long cylinders the diameter of a barrel, and with their forward ends tapering to a rounded point. They are big enough to party on, but small enough to trailer. The whole thing is driven by a gasoline power motor, generally 25 horsepower or above.

On pontoons, people can do whatever they do when picnicking at the shore, which is to sit, drink, eat, talk, fish from the edge, and jump in and out of the water. These floating islands are the perfect answer for those who don't own shoreline property that is actually underlain by soil. Never in my life have I seen more pontoons on the water from a single vantage, perhaps fifty from a single vantage point on the shore.

Further up I stopped at something labeled "Dead Stream Swamp," on my map. It's more marsh than swamp, having no trees and being inhabited by muskrats and great blue herons. Apparently this enormous wetland had been drained by the early settlers who thought it would improve things, which it didn't. Recently, residents reversed this process by building a dam and raising the water back to where it was.

Water control structures for maintained marsh at Houghton Lake Michigan.

The drainage ditches have become canals, though no boats are allowed to use them. This is a very good idea.

Marshes adjacent to Houghton Lake, Michigan.

My last look at Houghton Lake was at the end of Yeager Road opposite Long Point. There, the water was a slightly cloudy distinctly brown. I suspect this was from the dissolved organic acids associated with the nearby wetlands.

The shore is a case study of overdevelopment.

Shoreline of northwest Houghton Lake, Michigan

There were hundreds of boats on dozens of long docks serving an untold number of homes pressed up against the shore. Beach sand was imported. Boulders guarded some shores, sheet pilings guarded others. Everyone I saw looked completely relaxed, which is a good thing. No one seems to have a care in the world, which is not a good thing from the point of view of shoreline restoration.

Lake Management as People Management

Between Houghton and Higgins Lakes, we stopped for a pick-me-up at Little Cottage Ice Cream Shop, which was great. There, I interviewed a family of five; Jeremy the dad, Margaret the mom, Jarid the son, and Leanna and Shelby, the daughters. All were having some down-time and enjoying ice cream's holy trinity of sucrose, fat, and a trace of milk protein. The parents had both been raised in Flint, and were frequently brought here as children on holiday. Today, one generation later, Jeremy and Margaret brought their kids up for the long Fourth of July weekend. Though staying on Houghton Lake, they had gone to Higgins Lake State Park to swim because the water wasn't so "yucky."

When I asked the family about water issues, nobody had anything to say. Thoughts about water? Highs or lows? Anything? Jarid sensed me getting desperate, so he replied "seaweed," exposing his blue tongue as he spoke (he was eating that artificially colored blue ice cream). This was in reference to the "seven lakes" back near home in Flint. As gently as possible, I let him know that aquatic macrophytes were neither weeds, nor were they from the sea.

After giving him my card, the attendant at the gate of South Higgins Beach State Park let me in for a few minutes with the driver's license as collateral. The place was absolutely crammed. No lake could stand such attention if it happened every day.

Heavy use of South Higgins Beach State Park near 5:00 PM, Sunday, July 6. Note armada of boats in the water.

Upon reaching Higgins Lake, the first thing I saw was a sign precluding people from bringing their animals to the beach. The second thing I saw was a young man with his dog on the shore.

Sign with man, dog, and girl friend on South Higgins Lake State Park, Michigan. Within moments, man and dog were swimming.

They soon went for a swim together in the company of hundreds of witnesses. Nobody,

including me, made a comment. Why do people believe they are above the rule of law? This is one of the most persistent problems with lake management. People just do what they want, in spite of regulations.

As I approached the beach, I wondered how such a beautiful, azure-colored lake could stay so clean, and maintain such a healthy trout population. Aside from good regulation, and strong springs, I suspect it's primarily about the lake's depth, which reaches 135 feet. Half the surface area lies above water more than 50 feet deep. Depths like this ensure a large lake volume relative to its surface area, which keeps the average temperature down, which keeps the oxygen content high and the algal population low.

In spite of its clarity and the number of people swimming, the sign near the park store reported the presence of "swimmer's itch." This is a shistosome parasite that bores into your skin and creates a local infection. It's also a sign of eutrophic waters.

When leaving the lake we crossed its clear-flowing outlet, the Cut River. Thinking it was unusually straight for a natural stream, we slowed to read a sign. It was cut during the timber days to enhance the transport of logs to Houghton Lake. If the flow were the other way around, Higgins Lake would not be quite so nice.

Man Killing Clam?

Our last stop before Mackinaw City was Sea Shell City [www.seashellcitymi.com] in Cheyboygan. It's a roadside tourist trap that's proud of its reputation as "Michigan's Largest Retail Dealer in Shells and Coral."

Man-killing clam at Sea Shell City, Michigan.

What drew me in was the “man-killing clam” (*Tidacna gigas*) advertised on their billboard. Leslie, the vice president did point out that their sign near the clam didn’t say “man-eating.” Everyone should know that clams are filter feeders without teeth, organisms that live on microscopic things like zooplankton and algae. Baleen whales are also big, but that doesn't make them scary. They too are filter feeders, harmless vegetarians. So why does the sign in the store say: “Legend has it that the GIANT CLAM indeed have the capacity to snuff out mans life with one sharp snap.” Maybe. Maybe not.

Leslie Earl, the vice president, had a few issues with water. On the down side, she “doesn’t like people walking on my beach.” (Here, she is referring to a public beach on Lake Huron.) On the up side, she said “ I can swim in the water and not worry about being eaten,” referring to the beaches near Miami where she takes some time away from northern Michigan.

Kim, her employee, had even more interesting stories. She hates "them dang zebra mussels. You can't go swimmin' without cutting your feet up." She says the Canadians are making the Great Lakes Salty with the Soo Locks, which doesn't make much sense to me. She also says we've now got dead gulls from dead fish from zebra mussels with botulism.

In spite of all this, the gift shop is full of positive thinking, for example the saying on the T shirt I almost bought as a house gift for my sister.

Sign on a T-shirt in a Cheyboygan Michigan gift shop sets the mood for the day.

Within minutes, we were back on the road heading for Mackinaw City for the night. A full-sized billboard on the road caught my attention advertising www.sulfideminingkillsrivers.org. It’s pretty clear what that’s about.

We arrived in time to photograph our third Great Lake before dark.

Lake Huron looking east at the Strait of Mackinac, Mackinaw City, Michigan.

Dinner brought us a surprise, a fillet of whitefish hanging over the edge of my dinner plate. It's a regional delicacy, akin to lobster from Maine and salmon from Seattle. Whitefish travel in great schools, and are only freshwater fish in the area known to do so. Their flesh is high in protein and oil, which made them excellent fish to smoke. With wild rice, a piece of smoked whitefish could keep a voyageur going all day long.

In the trading post was a section for taxidermy sales. There, I discovered that some people would part with up to $500 in order to get a stuffed raccoon.

Dead raccoons for amusement at the Mackinac Trading Post, Mackinaw City, Michigan.

They may have been trapped in suburbs as nuisance animals, or worse raised on farms, or even worse, trapped in the wild for amusement. Regardless, I think this constitutes unethical treatment of animals. I would not want to be stuffed and mounted like this. The water story here involves the definition of amphibious. Nobody would call a raccoon an amphibian, but they are certainly amphibious. Though they nest in trees of the forest, they get most of their food at lakeside. Among the cleanest and smartest animals, they wash their food before eating it.

Day 9 – Michigan's Upper Peninsula.

"Flying Rats." That's what the attendant of our motel screamed at the seagulls, who were pestering those of us eating breakfast in the blinding-bright sunlight. We were in Mackinaw, which can also be spelled Mackinac, with no change in pronunciation whatsoever.

Mackinaw City

Our first stop was to the state pier. There we found an icebreaker to remind us that lakes sometimes develop a solid crust.

Icebreaker moored in Mackinaw City, Michigan.

In fact, it is the freezing of lakes that that gives them their unique seasonal behavior of turning over twice per year, bottom waters mixing with top. The thermal expansion of ice and the floes released during breakup provide a strong land-shaping process akin to ice thrusting by glaciers.

Next I saw a sign so self-evident that it was like putting a "danger" sign on an un-caged lion.

Message on drain at the city pier in Mackinaw City, Michigan, posted directly above the water.

Where else would it drain? Never have I seen such clean water in a working harbor, not even at the edge of the sea.

Water clarity of Lake Huron at Mackinaw City, Michigan.

Landscaping the pier were Matt and a co-worker. When I asked him if he had a water issue, it didn't take him long to answer, "the levels."

He's referring the recent scare that the water level of the Great Lakes has been dropping for about a decade, getting everyone worried that this is an initial signal of climate warming. In the recent past, the levels dropped as much as ten feet, although they've come back up this year. In fact, the pier he is working on had to be redesigned to accommodate this change. It has floating docks with down-ramps that resemble those designed to accommodate tidal variations on the sea.

Rising and falling lake levels are nothing new. Good instrumental data is available for the past century on the levels, which rise and fall on a schedule related to climate, but in complex ways. Geologists and paleohydrologists have worked out longer records that show rises and falls at the millennia scale. Even longer records are provided by glacial lake shorelines. On thing is sure: The Great Lakes will be around until the next ice age.

Downtown

Annette, a matronly, dark-haired, woman in her sixties was "manning" the counter at the Chamber of Commerce Visitors Center. She was the only one on the whole trip to comment on my new cap, which reads "The Thoreau Society." She wondered which of the many Thoreau's I was related to, a common name in French Canada, one of Huguenot origin. When I asked, about Henry David and Walden Pond, she said she had no idea who he was or why a pond would be significant.

Someone named Carol from Cheboygan walked in and looked at me as if she knew I would interview her about water. She liked the idea that you could drink the water straight from Lake Huron. Her main issue was swimmer’s itch, which limits where her young children can swim.

Across the Street was The Island Bookstore. Two women were on staff. Kathy's family has lived on nearby Black Lake in Cheboygan. Inland lakes and the lazy rivers that connect them are much warmer than the Great Lakes, allowing people to swim. Three generations have grown on the water during the summer months. It is central to their identity. How odd to live on the edge of magnificent clean lakes, yet retreat inland to enjoy everything but the view.

This, of course, is due to a most unusual property of water, known as its heat capacity. As a substance, water can hold several times more heat than soil or rock, meaning that it warms up and cools much more slowly. Given the cold winter climate of the northern Great Lakes and the enormous volume of water within them, the water temperatures never catch up to smaller inland lakes and lag far behind them in season.

Swimming is not the attraction, cooling down is. We made transit of the whole shore of Northern Lake Michigan from St. Ignace to Escanaba, and didn't see a single person in the water. Not even at our waterfront hotel room in Mackinaw City. People do swim on hot days in August, because we've seen them many times and we have swum off the beaches ourselves. But not today. The July 6 air temperature at 12:32 had reached a high

of 62 degrees Fahrenheit. The water was probably in the mid 50s. Wearing a wool coat on the Forth of July weekend (which we witnessed) is apparently preferable to sweltering in Detroit on the street.

Kathy's main concern was about Canada selling water to the southern United States. Her vision is that they have water pipelines heading for Colorado and beyond from Lakes Superior, Michigan, or Huron to complement the natural gas pipelines already heading to Michigan from the high northern plains of Edmonton and Calgary. The eight states of Minnesota, Wisconsin, Michigan, Illinois, Indiana, Ohio, Pennsylvania, and New York are firmly against this idea, and several voted that way last year. But who knows? All it takes is a majority in Congress and a 2/3 majority to override a veto.

There's an ocean's worth of fresh water in the northern Great Lakes. This buoy at Mackinaw City, Michigan sets the scale.

Elizabeth, the other employee, just wishes "they would leave the lakes alone." She is referring to recent suggestions to poison the zebra mussels.

Just before leaving Mackinaw City I went to photograph the famous Mackinac Bridge, which is five miles long and connects Lower Michigan to the Upper Peninsula, pronounced, "you pee."

Mackinac Bridge connecting Mackinaw City on the Lower Peninsula to Saint Ignace on the Upper Peninsula.

My attention was instead diverted to the flock of Canada Geese (*Branta canadensis*) with rapidly growing goslings, swimming in formation. All seemed right with the world. This animal is forever stamped in my brain as a blessing, their garrulous flocks signaling a commitment to parenthood, the turn of the seasons and the emergent properties of nature. Over the last two decades, however, they've become a great nuisance. Each adult excretes about a pound and a half of noxious, greenish black feces that is the prime source of nutrient pollution in many places, especially suburban lawns and golf courses.

Northern Shore

Practically every visitor heading west around the lake is treated to a series of billboards announcing the presence of the famous "Mystery Spot." I don't know what it is, and prefer to keep it that way. The way I figure, if I learn what it is, it won't be a fun any more. To me, the mystery spot is a lot like religion. I'm fully aware that life is full of mysteries that will never be solved by observation or reasoning. So I don't even try, despite the fact that I'm quite literally a card carrying scientist.

Mystery Spot, Michigan, the tourist trap.

I left another mystery behind as well. Between Saint Ignace and Naubinway are more than a half dozen roadside "party" stores selling three hot-ticket items: smoked fish, fudge, and pasties. For years we've driven by those signs. Not once have I stopped to find out what a pastie is.

“Mediterranean Lite.” That's the phrase writer Anna Castillo used to describe Lake Michigan. I couldn't agree more. When I drove by, the water was azure blue above the white sand, and wine-dark further offshore.

The Great Lakes are inland oceans, complete with lighthouses, cargo ships, dangerous reefs, shipwrecks, and port cities connected by rail. And, like all natural waters, they are slightly salty, meaning they contain dissolved ions of familiar elements of sodium, calcium, chloride, sulphate, and many others in smaller quantities. The boundary between saltwater and freshwater is as arbitrary as the boundary between lakes and ponds. All water is mineral water to some degree, unless distilled in a lab. Some parts of the ocean are saltier than others. Some water on land is far saltier than the sea.

The beaches of Lake Michigan even look like those of the ocean.

Unnamed Beach on the north shore of Lake Michigan.

They have gulls, breakers, a swash zone where the waves rise up and fall back down, berms where the waves have deposited clean sand, and dunes, some over a hundred feet. The main difference is that lakes lack a significant daily tide, though they make up for this with variations in level caused by the water balance. The dichotomy of lake vs. ocean is more about something that can't be seen (salt) then what can.

Dunes on the north shore of Lake Michigan.

Some of the beaches, some of the time, have singing sands. When you step on them, they make a noise. The noises I heard were more like dog barks.

Hog Island came and went. This is typical agricultural practice, to let hogs graze on islands with no way to escape. It's cheaper than feed or fencing. Top of the Lake was next. This is bleak country, with little but swamp and taiga beyond the edge of the lake.

Nearing the town of Gulliver, we began to see outcrops of reef limestone, which is chalky white and full of voids. Soon, the low, light gray road cuts began to resemble those of central Ontario, or upstate New York. Though we were n the Upper Peninsula of Michigan, we were still on the continental platform, not the Canadian Shield.

In this vicinity were a few structures built of dry-laid stone. I saw two cellar holes and a few stone enclosures with fences about six feet high like those of western New England and the British Isles. I wondered what the historic connection was. But I resisted an investigation. After all, this is a lake by lake trip, not a *Stone by Stone* one. (That's the title of my previous book on signature landforms).

Manistique

The gasoline at $2.78 a gallon didn't bring me in. Instead it was the giant statue of Paul Bunyan; locate at the Chamber of Commerce tourist information center in Manistique, Michigan.

Statue of Paul Bunyan in Manistique, Michigan.

It was completed May 16, 2002, and built of plastic composite. This summer it will get a

new coat of paint from Lenore Derouin, a self-described artist, who doubles as Director of the local Chamber of Commerce. Every Chamber would be lucky to have someone this nice working on his or her behalf.

Next to the statue was a sign with a colossal error. "Manistique: Home of Paul Bunyan." Everyone knows that Paul Bunyan is NOT from Manistique. He's from everywhere, especially my home town of Bemidji, Minnesota. I've seen towns in Wisconsin, New York, and Maine that try to claim him as well. My proof that he's at least from Minnesota can be found in Hackensack, because that's where his wife Lucette is from and where Paul Jr. was born. I rest my case.
Manistique could just as well have been named Watertown. A river runs through it, there are thousands of lakes and ponds to the north, and several to the southeast, where Lenore was raised, Gulliver, McDonald, Clear, and Lake Michigan itself. She was a water baby, swimming at such a young age that she can't remember learning how. And because she could swim, she had freedom: her parents let her wander freely, even when young. She has another interesting family story to tell. When cleaning up after her grandmother died, Lenore found the most authoritative history of Manistique ever written. It had fallen behind her dresser chest of drawers.

On the down side, Lenore wonders why her water bill is so high, though I wonder why she has one at all. She and her husband, who she described as "tribal" in reference to the local Native American group, pays the local water utility more than $100 per month for water, even as she is everywhere surrounded by it.

It was in Manistique that I decided to commemorate this road trip with a collage of water-tower photographs.

Historic Water Tower in Manistique, Michigan.

This tower, made of brick and stone, is on the National Register of Historic Places. Here, the tower must be mostly about the power to deliver water to those who need it, rather than the availability of the pure substance, which surrounds the town on all sides. The water tower is located at the site of the Schoolcraft Museum, which was closed. Appropriately, it was located in the largest city in Schoolcraft County.

Cabin at Schoolcraft Museum, Manistique, Michigan.

Though I was a visitor, I was likely the only one in town that day who claims Henry Rowe Schoolcraft as a hero. Manny Rodriguez, Tom Brady, and Paul Pierce (athletes my son's talk about) mean nothing to me compared with Schoolcraft, warts and all. A smart, gusty, and determined young man from near Albany, New York, he began his career as a mining geologist, documented the source of the Mississippi River in 1832, and then became America's first ethnologist.

To the west was Michigan's largest spring.

Northwest Shore

We passed through Escanaba on the strip of U.S. Route 2. On three occasions, we saw brightly colored plastic fish mounted on poles.

Folk art in Escanaba, Michigan. Used Saw blades put to good use.

Everyone gets the same blank fish body, but adorns it in their own style. This is community-building folk art, similar to what we saw in Vermont but done with a blank moose. And though it wasn't on our trip, I've seen the same thing done in eastern Connecticut, where the blank is a white frog. Note that all three creatures – fish, moose, and frog – are water creatures, appropriate for a freshwater journey. What do they use in Phoenix? A rattlesnake?

How sad. We're rolling through Bark River, Michigan, a completely landlocked place with no river, lake or conspicuous natural feature. Yet here, with no natural attractions, we find an enormous casino, complete with an adjacent hotel, parking lot, and plastic signs with palm trees on them. This place illustrates the sadness associated with Native Americans. They suffered military defeats, campaigns of ethnic cleansing, and genocide, but never the "final solution." Instead, they were usually given lousy land for reservations, tracts that nobody else wanted. I suspect this is what happened in this place, which is located on a patch of flat land with acid soils barely above the swamps all around.

Legalized gambling, euphemistically called gaming, is often controlled by out-of-tribe, if not out-of-state, if not out-of-country investors. Perhaps they thought that plastic palm trees mimicking those of Las Vegas would look good in Bark River. They don't. Surely there must be a better way to restore the dignity of an almost-lost lost culture.

The town of Spaulding-Powers is so small that it must have merged in order to get a spot on the map. This is lumber country. Some guy must have had so many old saw blades he didn't know what to do with them at first. But then he got creative; making beautiful folk art out of rusty saw blades, most of which were at least three feet in diameter.

Saw blade folk art, Spaulding, Michigan. Detail on top and signs for sale to bottom.

The pictures say it all. If you like them, call the Poupore family or look for the outdoor display on the south side of U.S. 2 just east of County Road 563.

Iron Man

Tom Maynard, with an accent on the last syllable, is a young man from Vulcan, Michigan who goes by the nickname of "Moose." He could easily make a living as a model posing for Paul Bunyan, or as a bouncer at a biker's bar. I found him sweeping out an old gas station he's converting to be "Moose's Bait and Tackle," which he hopes will open soon.

Tom Maynard (a.k.a Moose) with his daughter Aryonna in Vulcan, Michigan.

Kristine pointed out how he dwarfed me when I stood beside him. His beard is jet black, his shoulders as broad as a wheelbarrow, and disposition gentle, and his intelligence compelling. With Moose was his four-year old daughter, Arryonna. His son, Thomas Jr., being only two and half, was at home, presumably with mom.

What drew me here was an enormous, and anomalous, statue of a black bear standing seventeen feet tall and twenty-eight feet long. It was constructed in the summer of 2000 by an artist from Chicago named John Radlovic who wanted to help draw tourists to this town with a dead iron mine, which is located downriver from the city of Iron Mountain which has an even larger dead iron mine. This story is documented in the Daily News (Iron Mountain/Kingsford) dated September 26, 2000. A complementary cement wolf is planned for later this summer.

The number one problem with freshwater, according to Matt, is the single invasive species known as Eurasian Milfoil. It's choking out native aquatics and covering lakes all around. Number two is the zebra mussel, which is coating nearly every fixed surface with razor sharp shells. He has a third gripe with government agents, especially the County Commissioners, who, he alleges, take your money and do nothing with it except make it disappear.

Moose's main identity is that of an outdoorsman. He hunts, traps, and fishes as much as he can. The best thing about freshwater, he said genuinely: "is to carry out m outdoor legacy for my kids." If there were more guys like him, Nature Deficit Disorder would not be a problem for our nation's kids.

Ten miles further downstream on Highway 2, in the City of Iron Mountain, was a sign directing us to the Cornish Pumping Engine & Mining Museum. I recall reading "largest in the world."

Cornish pumping engine, Iron Mountain, Michigan. Note woman to scale at left on platform.

I'll let the facts speak for themselves:

- Flywheel is 40 feet diameter.
- Engine if 54 feet tall.
- Began operating in 1893, ended in 1914.
- Total weight is 725 tons.
- Burned 11,000 tons of coal per year.
- Designed by Edwin Reynolds, chief engineer for what became the Allis-Chalmer's Company of Milwaukee, Wisconsin.
- Pumped water up from 1,500 feet below the surface.
- Pumped 300 gallons per stroke of pistons, up to 5,000,000 gallons per day.
- Ten revolutions per minute on the flywheel, each six seconds in length.

Most of the miners came from Italy, apparently because that is where the mining company had contacts.

Italian miner. Photograph from the museum, Iron Mountain, Michigan.

Such are the immigration stories of so many towns in America. Where you went depended almost entirely on whom you knew.

Northeast Wisconsin

Just over the Wisconsin border was a cartographic Rorschach test. Clusters of small kettle lakes are known to be chaotic and irregular in shape, mimicking the stagnant ice blocks that melted to create them. Here was a whole chain of small lakes was merged to form an irregular cluster. Someone saw a spread eagle from the shape on the map, and thus the name of the town – Spread Eagle -- was born. To me, the shape more closely resembles Elmo, one of my favorite characters from Sesame Street who was always spreading his oversized hands. But, then again, I wouldn't want to live in a town named Elmo.

We entered Forest County near Tipler. The moraines were coming; we could see them along the side of the road, sand and gravel hills with small lakes in the depressions. Soon

we would be in Vilas County is nationally known for its high concentration of kettle lakes.

Water Smeet Lake, Eagle River, Wisconsin.

We didn't' get to stay long. Not finding a place with Internet access, we decided to head south toward the big city of Rhinelander to check into a roadside motel for the night. Driving between Eagle River and Rhinelander was like hearing the same lovely musical phrase over and over, but in this case it was one of hilly forest, flat bog, and sparking blue lake rimmed by cottages. Sugar Camp Lake, and Jennie Lake are but two examples.

Day 10 – Wisconsin's Ice Age Trail

What a beautiful day to wake up in such a beautiful place as Rhinelander, Wisconsin. Our good weather since crossing the Adirondack Mountains has been as consistent as the bad weather on the other side. Today we were eager to reach North Saint Paul, Minnesota, where my little sister lives. It lies just a few miles west of the Wisconsin border.

Within a few minute we passed a series of bogs, which cover most of the map sheet.

Bog in northern Wisconsin near Woodboro.

In this stretch, and from the map, are only three categories of drainage make sense. The land is either lake, bumpy hills of sand, or flat bog. Bog is by far the most common surface material. So little attention is paid to bogs that practically all are unnamed.

Who Gets the Water?

Imagine three hungry kids and one cookie on the table. That's the situation facing Jackie at Lake Nokomis, who I met while she was out front tending her petunias. But in her case, it is not the cookie being stared at, but a body of water wanted by three separate

entities, even in well-watered northern Wisconsin

Lake Nokomis is a name slapped onto a body of water officially called the Rice Reservoir, near Heafford Junction. I suspect a real estate developer with a good ear for marketing picked it. Jackie called it a "flowage," meaning the water "goes up and down." I correctly guessed what she meant: the lake an expanded reach of a river, one holding water behind a dam that regulates the flow.

Lakefront on Lake Nokomis, Wisconsin. Wide beach is due this being a "flowage," regulated by a dam at its outlet.

The first of three users is the paper mill at the head of the flowage, which created the reservoir to back up the water to increase the volume. They did this because industry learned long ago that "the solution to pollution is dilution." Most are, or at least were, regulated not by the amount of chemically tainted wastewater they release, but by its concentration. The same quantity poured into a larger reservoir lowers the concentration, making effluent legal. They treat the lake exactly as if it were the tank above a toilet. The larger the amount in the tank, the more efficiently the unwanted residues are flushed.

The second group of users, in historical sequence, is the lakeshore residents. What they want is a good-sized body of water with a stable shoreline and clean water. Luckily, they got there after the paper mill no longer was allowed to release chemical surges. The third group is the kayakers, who assemble once in a while downriver to do their thing. What they want is a torrential release of water to make the otherwise sluggish flow challenging.

Users at the head of flowage (industry), along its edge (lakeshore owners), and below it (kayakers) compete with one another like three kids with one cookie.

I began my conversation with Jackie by asking what she liked best about life at the lake. "It's relaxing," she said. "The sunsets are beautiful." Her biggest problem is invasive

weeds, mostly milfoil, which is choking out the shorelines. We then got into a discussion about who is responsible and who should pay for this problem. Ultimately our conversation was about the failure to get a lake association here. Why? Because the residents simply can't agree on how to best manage their shared resource.

There is a volunteer citizens group called the Nokomis Concerned Citizens. The town is also involved, as is something called the Valley Improvement Association. The citizen group solicits donations from shoreline residents and hold fundraisers, one of which is the Pond Polka, held on Pontoons, if I heard the story correctly. They use the money for testing, cleanup, and so forth, but it isn't enough. Meanwhile, the Wisconsin State Department of Natural Resources (DNR), which is responsible for overseeing lakes at the state level, has required the residents to get rid of the milfoil, and tries to enforce behavioral regulations such as the one requiring that people can't drink alcoholic beverages while driving a motorized boat. Nor will they allow lakeshore owners to protect their eroding shorelines with riprap, meaning boulders or rock, at least according to Jackie.

One look at Jackie's lakefront reveals why she might not want a lake association. Her property is beautiful, one than many citizens would envy. There are no trees to block the view or drop leaf litter or twigs on the immaculate grass running right down to the shoreline. The lush garden is full of flowers. Tidy boats rest on clean sand where the water used to be (it's drying up). Any weeds (large, rooted aquatic plants called macrophytes by scientists) have been grubbed out and raked clear. .

She is what the environmental activists and those who understand shoreline ecology would call a "neat-nick." Nature, they argue, isn't that neat. The shoreline needs shaded spots. It needs some rooted plants and a few irregularities in the water like boulders and deadfall trees. It needs a "riparian" edge immediately above the water with plants such as herbs, wetland grasses, sedge, and reeds. It needs lawns that are not fertilized or treated with chemical sprays.

Jackie isn't being criminal. Nor is she anti-government. And she believes the state DNR has done some good things. But she wants them to "tone it down," with respect to regulating what private citizens can, and cannot do on their shared piece of property. "They need to look realistically" at the situation…"you don't want to ruin tourism" by raising taxes and increasing regulation.

A lake association on Lake Nokomis – or any lake for that matter – would be a good thing. Though I don't know the details, the failure to get one here is probably less about government and regulation than it is about education. I believe that if every lakeshore owner actually understood how lake's work, agreement would be much easier to achieve. Ultimately, this boils down to education, both for kids and for kids of all ages.

Higher Power Tower

In the tiny town of Glen Flora, Wisconsin is one of the cutest churches I've seen. Of course, it's a Lutheran Church of some sort, in this case led by the Reverend Hanson. Behind it is the nicely, and unpretentiously painted water tower with the name of the town in simple block lettering.

Lutheran Church and municipal water tower in Glen Flora, Wisconsin.

I stopped there for a photo to add to my growing collection of water tower images, which I plan to turn into a poster at the end of this freshwater journey. The seacoast has its lighthouses. The heartland has its water towers.

A water tower looming above a church said something to me as a scientist. When I hear the old saying, "There's nothing certain but death and taxes," I often think about gravity. It is such a given, such a constant in our lives that no storm, power outage, heavy snowfall, downed tree, or human error can stop it. We don't put water tanks up that high because we want to store water. We do so because we want to store water AND energy, in this case, the potential energy of gravity, and the force hat makes rivers flow from high to low. And a higher tower translates into higher power, which can be used to raise the pressure. May the force be with you, the force of gravity? Let that higher power distribute water far and wide.

In front of the church was a bright red fire hydrant.

Fire hydrant connected to the higher power water tower in Glen Flora, Wisconsin.

What a perfect place for a hydrant, being so near the tower of power. Indeed, when someone's house is burning, the firefighter wants to fill the tank of his or her truck as fast as possible.

Island of Culture

Tony was a few miles down the road. It's not a him, but an it, a one-gas station town. Lila was filling up a gas can. She glimpsed my way and stared for a second or two. I suspect she saw my Connecticut plates and wondered what a Volvo was doing here in the almost exclusive land of GMC and Ford cars.

This emboldened me to ask about the highs and lows of freshwater. Being an outsider, she was more than happy to talk, share her thoughts, and to have some company. She's lived here for only five years, which may not be enough to be accepted by the community. Before that she lived in Iowa, moving up north in retirement to live on the land her grandmother had owned when Lila was a child and visited here. This move, she said, was a "going back to your roots," sort of thing.

Her water concern involves climate change. She's noticed that, ever since she came back north, there 's been a drought, with the grass turning brown even in July, and the water table dropping. I never heard her "good side" of the story because her observations of local culture distracted us. To her, the local folk strange, closed to outside people, not open to outside influence. "They just want to do what they want to and be left alone," she said somewhat clinically. It's like there's a little island of people who just want to keep to themselves."

Things are different in Hayward," she continued, "with lots of seasonal people coming and going from all over." She was referring to "lake people," who she found more cosmopolitan, unlike the farmers who lived near Tony. Fascinated, I inquired if she had noticed something similar in Rhinelander, where I had just come from. "Yes," she said. "Certainly!"

Rhinelander is also kettle lake country, chock full of those who come and go. Being a glacial geologist by original training I prefer to think of the summer folk in Rhinelander and Hayward as moraine people. An early advance of the Chippewa Lobe moving outward to the limit we would encounter in a few hours, had pasted the land near Tony with loamy, rather than sandy, till, a compact form of surface soil that holds water well, and is perfect for corn, soybeans, and other commercial crops. When the ice lobe melted back, it left lonely a few patches of sand and gravel and gravel in the vicinity.

The final step was a re-advance of sub lobes to the west and east, which covered Hayward and Rhinelander, respectively. This blessed both towns with hundreds of lakes each, but cursed them in terms of agricultural purposes, except for growing hay and grazing cattle. Indeed, there is an island of people near Tony. Their culture a restricted to an island of loamy till that's surrounded on all sides by lake-studded, sand-gravel moraine.

Just before we parted, I thanked Lisa for her acute observations of physiographic determinism. She looked at me a bit funny, so I defined it. It's a theory that holds that the physical landscape shapes the culture of the people who live on it. The philosopher Will Durant understood it when he quipped: "Civilization exists by geological consent, subject to change without notice."

Leaving Tony to the west, we passed just below the Dairyland Reservoir, which surrounds "Bunyan's Hat Island. I'm guessing that this is a tribute to the timber economy enclosed within a tribute to another more sustainable one. Within a few miles were in Ladysmith crossing the Flambeau River, another impoundment with no visible flow. Its weed-mantled surface was sad.

Ice Age National Scientific Reserve

We headed south on Wisconsin Route 40 to a place near Bloomer that has three official-sounding names. To the state, it's the Chippewa Moraine Ice Age State Recreational Area. To the National Park Service, which funds much of the operation, it's the Ice Age National Scientific Reserve. To the citizen activists who helped found this site, it's the Ice Age National Scenic Trail, which follows the outer limit of the last major glacial advance in Wisconsin. The country beyond the trail is completely different.

The kids I saw at the ice age park didn't care. They were too busy doing a nature scavenger hunts. Environmental education is the main activity that takes place for kids. For adults, it's probably dominated by foliage hikes in the fall, boating in the summer, and cross-country skiing in the winter. What a great idea…a reserve dedicated to glacial geology. It felt so good to be in a place where people knew the difference between glaciology and glacial geology, and didn't seem clueless about their effects on the landscape. Having just finished teaching an upper division specialized course on the subject that uses a 600-page text, I'll spare you the details for this road trip.

Painting in the Visitor's Center at Ice Age National Scientific Reserve, near Bloomer, Wisconsin.

The painting is not realistic. Rather, it's a collage of images from between 10,000 and 15,000 years ago.

Brenda was outfitted with the classic park service uniform, complete with polished badge and a pin that had 1991 written on it. That's when she joined the Wisconsin DNR as a LTE. As you know, state and federal employees are excessively fond of acronyms. An LTE is what normal folks would call "summer help." With this agency, it's a "limited term employment," a job title that's pretty clear about their plan to "let you go" in the not to distant future. Since then, she's risen to the position of supervisor/naturalist, which she

no doubt earned on her own merits.

What a great person to have working in such a place, able to let me down gently with the correct identification of a moth, after I screwed up, and more importantly, able to confidently interrupt adult conversation to deal her top priority, which are the many kids scurrying around the place. God bless anyone who helps kids stay in contact with nature, especially those who do it for a living. She specifically mentioned working with Tm Gilbert and Pam Schuler from the park service on a variety of projects.

It's only July 7, and the grass is already turning brown. The surface soils are dry because the building sits on a pile of well-drained sand and gravel that was dumped into a pond surrounded on all sides by glacial ice. There is no surface water anywhere in the areas except where the water table intersects the land surface, producing hundreds of small kettle lakes.

The local drought and declining water table, and the consequences thereof are Brenda's main concerns. Their signature lake, Shattuck, the one seen through the picture windows out front, is usually a continuous sheet of blue water running right to the forest edge. Now, the water is so low that a wide rim of lily pads and other aquatic weeds surround it like an amoeba-shaped green frame on an amoeba-shaped painting.

Lake Shattuck from the front of the Ice Age National Scientific Reserve, Bloomer, Wisconsin.

Visitors are having trouble launching boats because the water levels have dropped below the roads leading to launches. There's also a drought of funding, she says. Things are tight in every government agency at every level.

The good news is what Brenda calls "willing acquisitions." People are actually giving land to the government to preserve it in perpetuity, and many others are selling land to add to the park property. Even better news is the fact that they have access to thousands of young minds each year through their environmental education programs.

Beyond the Moraine

Interstate 53 is the main highway from the cities to the south and Wisconsin's northwest lake country. When we crossed it at Bloomer on Route 64, we had the misfortune to fall behind a caravan of slow-moving trucks carrying the rides for a carnival. Passing one didn't gain us much, for there were at least a dozen more ahead. This circumstance could not have happened in a worse place, the ridge-and ravine topography beyond the moraine.

The terrain between Sand Creek and Connorsville would make sense to someone from the Ozarks or West Virginia. The tributaries flow fairly straight and they link together into larger streams with a regular pattern. At the scale of square miles, it resembles the branching patter of the veins in a maple leaf or the Y-shaped forks of an elm tree. The divides between tributary watersheds are higher and ridge-like than in moraine country. They actually divide the flow.

When glaciers overrun such places they tend to subdue the local relief by wearing down the high spots and filling in the low spots. This didn't happen here because the ice sheet stalled further north.

This terrain was not covered by the last major ice advance. Collinsville, Wisconsin.

Connorsville is a place where the terrain hasn't been glaciated for at least 100,000 years, possibly as much as half a million years, ago. The land has had time to adjust back to nonglacial conditions. Its soils are redder and more clay rich, the boulders have disintegrated, and the watershed is better adjusted to the dendritic drainage pattern.

To visualize the difference between fresh and ancient glacial terrains, I suggest you download Google Earth software contrast the towns of Island Lake and Wilson, respectively, which are only twenty-five miles apart. The glacial terrain of Island Lake is centered on 45 degrees 18 minutes' north latitude and at 91 degrees 25 minutes' west longitude. The nonglacial terrain of Wilson is centered on 45 degrees 07 minutes north and 91 degrees 50 minutes west.

To the west was New Richmond. The water we saw there in town was the color of tea.

Entering the Twin Cities

Having spent two days working our way across Michigan and Wisconsin using blue highways and backcountry roads, Kristine and I experienced surges of adrenaline when approaching the Twin Cities.

View to the north of the Saint Croix as we enter Stillwater, Minnesota.

Our first rush took place when the road funneled us into a bedrock canyon with vertical limestone cliffs. This was the meltwater pathway draining much of the ice sheet edge to the north. So freaked out were we that we didn't manage to pull off at all for a photo.

Within minutes we had turned east on a four-lane road with stoplights of the sort that signify suburbia everywhere in the nation.

Within a few more miles, we turned right on Century Road, which parallels the official edge of the Saint Paul metro area. A quick left turn and one block down found us in the driveway of Ingrid, Peter, Maggie, and Henry Kohler, who will put us up for the night. Of course I screwed up. I was not supposed to arrive before 4:00. Instead, we pulled off the road at 3:50, ten minutes before Ingrid finished teaching a violin lesson to one of her pupils. This gave me a chance to interview my first twin-cities resident, Melody, who had come to pick up her daughter.

Melody's responses to my dichotomous (joy/concern; high/low; up/down; good/bad) question about fresh water was both articulate and full of grace. "A nice glass of cool fresh water," she replied for the plus side. For the down side, she said, "We do not take care of our resources, water being one of them." Each morning she has thoughts about nature in her prayers. She would love to live on a lake because "they're so peaceful."

The "calming effect" provided by surface water "is a gift from God that refreshes the soul." What a lovely thought about water. I couldn't help thinking of Henry David Thoreau's comment that "a field of water betrays the spirits that are in the air."

Downtown Saint Paul

I left early for my reading at Garrison Keillor's bookstore It was a small group because I don't know anyone except the families of sister in Saint Paul, that of my brother in Minneapolis, and an ex-graduate student who had spoken at Common Good Books just a few weeks before I did. I suspect that even fewer people know there's anything to know about the subject of my talk: kettle lakes.

Common Good Books, downtown Saint Paul, Minnesota.

I love independent bookstores. This one's located in the basement of an old hotel at the corner of Western Avenue and Selby Street in St. Paul, Minnesota. The sign says they carry General fiction and non-fiction, Good Poetry, Classics, Quality Trash, Midwestern Lit, and Local History.

The readings went well, and the conversations we had were intimate, funny, and very stimulating. Sherry, one of the people who attended was visiting from Denver. Of all the people I met on the entire trip, she was the most energized – one could say borderline manic -- about the politics of water. She had nothing good to say on the subject of fresh water because she didn't think there was any left at all. She had heard that the rainfall everywhere contains molecules of plastic. Irrigated golf courses were one of her pet peeves. It was hard to get her to stop.

To be parsimonious in conversation is to say the most with the fewest words. Robert won the prize over the course of the entire trip. He was a mellow guy, an elderly African American, wearing a cap from Enterprise Rent a Car and finishing his supper in Costello's Bar on Selby Avenue in downtown Saint Paul.

Costello's is across the street from this old hotel. Common Good Books is in its basement. Saint Paul, Minnesota.

It didn't take long for us to find something in common. We both had lived in Alaska, he working for six years on the pipeline, and me learning geology and archaeology.

"Algae." He said in response to my first question, following it up with "10,000." In two words he had been able to describe the lows and the highs freshwater life in Minnesota.

He's right on target with respect to the water challenge and water pride felt by most residents. The algae problem is fairly straightforward. There are simply too many people doing too many things that release too much soluble nutrient into lake waters. They don't stop at the edge of the lake. If there's and inlet, they stop at the runoff divide, the place where the water flows both toward and away from a particular spot. If there is no inlet, they stop at the groundwater divide, which may, or may not mimic the elevation of the land surface.

And, indeed, 10,000 may be the best thing about Minnesota lakes. Actually, there are many more than that, though the exact count, somewhere near 15,000, will probably always remain a mystery. Minnesota should consider itself lucky, not only because the ice sheet created that many lakes, but also because they're still around. Normally lakes are destroyed by being in-filled with sediment, usually bits and pieces of plant remains

mixed with mineral mud and clay. In Siberia, however, thousands of perfectly lovely lakes have disappeared in response to climate warming. They were held up by a layer of permanently frozen soil at depth which, when melted, allows the water to drain downward.

Of course, the televisions were mounted on the wall showing some sort of athletic contest. The bartender recommended a nice pint of micro-brewed ale for me to try. He did give me a funny – but not unkind – glance when spotting me handing Robert one of my business cards while sitting next to a briefcase, laptop, and large single-lens reflex camera. That's not normal tavern stuff.

Robert spends lots of time fishing. He likes it best in the spring and fall, believing that the fish don't taste as good in the summer, when the water is warm.

There wasn't much street life left at 9:30 on a hot Tuesday night. Most folks were probably near a lake of some sort, or perhaps at home reading my blog. Jonathan, who had attended my reading, was sitting alone at a table out front of Common Good Books, experiencing the oxymoron of enjoying the night air while smoking a cigarette. When I told him about Robert's two-word answer, he said "I can do it in four."

Lake Michigan. That's the concern. Like the beachfront in Toronto, it's closed most of the time due to fecal bacterial pollution. Another irony of lake life. For good health, we need them to live in our intestines. In fact, we have what microbiologists call an "intestinal flora." But when the feces from humans and warm blooded animals wash into the water and we ingest them, it's bad news. We get the runs, or worse.

Chicago River. That's the good thing. Jon laughed when he said this, saying he knows that it doesn't make sense. The concrete-rimmed river is terribly polluted, more like a gutter of gray-water, and the farthest thing from a babbling brook. What he likes about it is the fact that humans have figured out a way to make it run backwards. Originally, the river drained as a lazy stream from its divide with the south-draining Illinois River. This was the route taken by Farther Marquette and Joliet in their famous 17th century voyage of discovery that proved the existence of a great south-flowing river in the American mid-continent, one later given the name Mississippi. The gradient of the Chicago River was so low, that all it too to reverse the flow was a ditch at the divide and some kind of dam on the downstream side.

That's it. My experience with Saint Paul Street life ended after three city blocks of sidewalks to my car, a few dogs being walked to release water-soluble excrement on irrigated micro lawns.

Activist Kids

Maggie, my niece, will enter 9th grade in the fall. Her best friend, Haley will enter 8th. After I returned from the bookstore, I interviewed their kids about their highs and lows of freshwater. In their minds, both went immediately to the lake,

Haley liked "all the animals and fish," particularly the snapping turtle. What she didn't like the was the "seaweed yucky muck." When it was her turn, Maggie said she liked the lake because it was so much more interesting than the pool, and you could just lie there and get a tan with your friends." What she didn't like was the "muck and weeds." These girls were of like mind.

Some kids trying to save their lake.

Then the kids told me an astonishing story about Silver Lake in North Saint Paul, which is only one block north of their hose. One day, on a routine visit to the lake, they saw dozens of dead fish washed up on the shore and stinking to high heaven.

Though nothing to write home about, Silver Lake is the centerpiece of their neighborhood of middle-class homes built during the baby boom expansion half a century ago. Back from a dancing lesson, they sat in the same chair together, looking like they were joined at the hip (Recall that widening of the hips comes later in human development.)

After being grossed-out by the dead fish and afraid for the future, they printed "Save our Lake" flyers and tacked-taped them up all over the neighborhood. They urged residents to go down to City Council chambers and tell them to fix the problem." I'm so proud of them. I mean think about it, they could have been reading *People* magazine, doing their nails, and having their first serious conversations about boys. Instead they were out there pounding the pavement as environmental activists.

How lovely is innocence of youth. If only it were that simple. We discussed possible

causes of the fish kill. Poisoning? Ingrid, my sister and Maggie's mom told of a perfectly normal day when the kids were swimming under the watchful eyes of neighborhood moms. The boat passes by with equipment that was spraying fluids into the water well out from the shore, right in front of the swimming area. They later found out that this had been a lawn care company hired to spray herbicides on an adjacent private lawn. More concerned than indignant, the moms pulled their kids out of the water. That was the end of it. What was it? Why? Was it legal? These questions were left unanswered, simmered for a while during coffee conversations, and then faded away.

Day 11 – Leaving the Twin Cities

Having heard Maggie and Haley's story about Silver Lake the night before, I walked down to see it as soon as I got the chance. What could it be, I asked myself, that could kill a species of fish that are fairly resistant to environmental insult?

Urban Lake

Of course, I don't know what killed the fish. Perhaps nobody does. But Ingrid has an idea. She recalls as summer day when the kids were playing at the swimming beach and the moms were visiting while monitoring their broods. This was what I saw a week before at Walden Pond, with one exception, the mom's were not talking. Then all of a sudden, Ingrid watched a boat across the way that was about 30 yards from shore, spraying the water with pressurized nozzles. First they got the kids out, and then they went over for a closer look. It was a lawn care company who had been hired by someone on the opposite shore that decided to spray the lake as well.

Were not the timing of the fish kill the kids saw, I would have suspected a phenomenon called "winter kill," caused by the loss of oxygen beneath the ice. I soon found another set of clues to a potential killer.

Between the road and the lake were: a corroded cement culvert; a notch in the compact soil around the lake bracketed by a luxurious growth of grass; an abandoned channel cut below and into the small beach; a submerged delta composed of pebbles the size of walnuts; a veneer of organic flotsam and mud on the delta plain; and a truncation of the front of the delta sheared off by waves.

Storm drain entering Silver Lake, North Saint Paul, Minnesota. Not a good idea.

To a geologist, this is proof positive for the following sequence of events. Ambient conditions were followed by a heavy rush of runoff from the rooftops, driveways, patios, and streets that was captured by city drains and conveyed directly to the lake. This was followed by a rise in the water level accompanied by strong wave action. Arriving with that runoff were invisible residues of fertilized lawns, pet poop, the oil spots in the driveways, and much scarier stuff dumped furtively in backyards. All this was thoroughly mixed into the lake by density flows and a vigorous circulation set up by shoreline currents set up by waves.

But what was it that washed into the lake? Was it the chemicals washed off the nice lawns? I suspect that the main problem with the storm runoff was a surge of nutrient; possibly from an overloaded and leaky sewer system Plugging leaks would not solve the problem of waterfowl feces, a problem made much worse by the feeding of geese, ducks, and gulls as if they were pets.

City of Saint Paul Fire Department. That was the label on the water truck in the park. But the person operating it, a twenty-something named Jason, was far too relaxed to be a fireman on duty. Instead, he was an employee of the city's public works department, spending the morning watering the saplings of recently planted trees.

Jason is all set to water trees in North Saint Paul, Minnesota.

He was happy to answer my open-ended questions about the highs and lows of freshwater. His responses were as classic as they were revealing.

"The tap water is pretty good," he said in response to my prompting that he identify something positive. "No complaints." On the down side he said, "This was an older community." What he meant was that the water control infrastructure is outdated. Indeed, municipalities are now doing what they can to replace half-century old sewer systems, which are often full of leaks.

Old sewer infrastructure is a problem for many cities wishing to improve their water quality. This one is from Silver Lake area, North Saint Paul, Minnesota.

They are also trying to re-route storm water drainage away from standing bodies of water, to which it was conveniently directed before the crescendo of environmental concerns during the decade between 1965 and 1975, when the National Environmental Policy Act (created the EPA) of 1970, the Clean Water Act of 1972 (actually the amendments), the Clean Air Act, the Hazardous Waste Act, and countless others shifted the nations attention in that direction.

Many rural sewage plants are tiny, but effective. Isle, Minnesota.

The most revealing part of Jason's responses was how biased they were. Not in a bad way, but in a focused way. He works for Public Works. Hence, his responses are about public works: the quality of city water and the aging infrastructure for managing it.

Lake Calhoun

I'm not used to this. Getting there required major map work, merges, stoplights, and quick turns. People were everywhere, jogging, biking, walking, and sailing. Not one person was swimming, even on a nice July day

While waiting for Jeff Jones, I noticed that the edge of Lake Calhoun had been tractor raked of Eurasian milfoil. .

Edge of Lake Calhoun in Minneapolis, Minnesota, cleared of milfoil with a tractor-drawn rake.

This is a truly amazing plant. And a scary one too; an invader from another world.

Warning signs about invasive species are all too common in lake country. Mississippi River near Anoka, Minnesota.

At 11:00 sharp Jeff showed up for an interview that was later broadcast on Minnesota

Public Radio on Friday, July 10, and 4:50 PM.

Generally speaking, invasive plants, both on land and in the water, are the Dunkin Donuts of the plant world. There's nothing toxic about them. Botanically, they're fascinating. Many are beautiful, especially purple loosestrife, which is so pretty it was sold as a garden perennial. What makes invasive plants a problem is that they simply does a better job than most native plants in doing what a plant is supposed to do: getting nutrient, sunlight, and habitat space. In the human world, Dunkin Donuts gets most of the donut money, the most strategic spaces at the mall, and a steady stream of customers in search of the holy trinity of junk food: white flour, sucrose, and oil. Our bodies crave the trinity. Then it kills us slowly with obesity-related illnesses.

What makes floating aquatic plants like milfoil especially troublesome is that, during windstorms, they wash up on shore in great heaps where they block access and slowly rot to produce those fishy, sulfurous smells. That's why the tractor-driven rake came by.

Heading North

The City of Ramsey, Minnesota is new, or at least the vast majority of its domiciles are. I use the word domicile because I'm never sure what to call these structures flanking both sides of Route 47 heading toward Mille Lacs. What should I call them? Apartments? Townhouses? Condos? The look less like Levittown houses and more like the hives of oversized bees.

Ramsey, my blogging partner informed me, feels like the true edge of the Twin Cities metropolitan area. Here, where old meets new, is when she begins to feel comfortable again. In this case, "old" refers to the typical rural countryside reflective of land use patterns of the first half of the 20th century, before suburbs were king. "New" refers to the outward-spreading edge of a 21st century bedroom communities.

Indeed, the metabolic needs of humans haven't changed. We're still nearly three-fourths water by weight. Without water, we are metabolically dead. Hence, I'm sure water towers will be with us forever. The nearby town of St. Francis provided an easy chance to photograph one of these new towers.

Water tower in St. Francis, Minnesota

I caught the Fed Ex truck speeding by on purpose to capture the urgency of modern life. I contrast it with the old fashioned tower in Isle below it.

Mille Lacs

We pulled into Father Hennepin State Park to photograph the largest lake in Eastern Minnesota.

Father Louis Hennepin State Park in Isle, Minnesota.

This early explorer was the first to describe St. Anthony Falls, in present-day Minneapolis, Minnesota. This is the largest one west of Niagara Falls, which Father Hennepin was also the first European to describe.

Nancy, the attendant enjoyed fresh water for its swimming. She couldn't think of a concern.

Mille Lacs is the name of a single large lake, but the translation from French means "thousand lakes." This, we learned from the brass plaque on the boulder monument in Garrison. This western shore of Mille Lac Lake is where another Frenchman, a voyageur named Sier Du Lut (for whom Duluth was named), discovered many Sioux villages along the western shore.

Here we encountered a beautiful new statue of the most sought after game fish, the walleyed pike, or walleye for short.

Walleye statue in Garrison, Minnesota.

A.J. is a member of the Mille Lacs band of the Ojibwe who works at the Indian Museum in Kathio, Minnesota. On nice summer weekends, he said, there are as many as 14,000 anglers on Mille Lacs Lake, nearly all of who drive up from the Twin Cities to fish for walleye. That number struck me as so high that I though A.J. had added an extra decimal place. Even 1,400 anglers on a single Minnesota lake would be astonishing, if only for the gasoline it takes to get their boats and trailers here from the suburbs, and power the boats out to their secret fishing places.

Apparently, 400,000 pounds of fish are taken from this lake each year, practically all of that weight being from one species, the walleye. I couldn't resist doing a calculation. If 14,000 fishermen fished for ten good summer days, that would be 140,000 man-days of fishing. Each of those days would have produced less than three pounds of whole fish per day, which translates to less that two pounds of fillets per trip per man. That's mighty good eating. But just think of the poundage of carbon dioxide sent up into the air in search that experience. Is it worth it? Locally? Certainly. Globally, I'm not so sure.

A.J.'s main concern was about the rights of indigenous peoples the "white people." He explained that many Minnesotan's are disgruntled with recent federal laws that give the Native Americans special hunting and fishing privileges that are free of taxation.

Leaving Garrison, we headed north through Deerwood, where my twin brother lives. He was at work, so we didn't stop by. Next was the uneventful town of Crosby, furthest south of the old iron mining towns in Minnesota. Seeing the old mining museum got me to thinking about or first encounter with big scale mining in Iron Mountain, Michigan, two days before.

Algae growing on shore of Mile Lacs Lake indicated nutrient pollution.

We crossed the Mississippi at Aitkin. At this point, it's a typical river in every way except for its excessively winding habit.

Mississippi River from the bridge on County Road 1 in Aitkin, Minnesota.

Hackensack

Paul Bunyan's wife dominates the waterfront of Hackensack, Minnesota and may have dominated him as well. After all, her statue is three times larger than his. She is featured, he is not.

Statue of Paul Bunyan's wife, Lucette, from Hackensack, Minnesota.

Hackensack is alleged to be the town of her birth; it's also a quirky, and completely fascinating place. Inside the general store are all kinds of north-woods and lake-related items. My favorite, was a candle stand made of a simulated fishing lure.

Candle stand in Hackensack General Store, Hackensack, Minnesota.

When I put the water questions to the cashier and sole employee, Wendy said the biggest problem with water around here is that she ran out of bottled water for her "pop cooler." When a Minnesotan says, "pop," a New Englander in the same circumstance would say "soda." Visitors to the store keep coming in for water, but have to leave the store without it. I'm glad that water is in such demand. It's certainly better for you than soda pop, which is the full name. Apparently New England got the first half of the name, "soda," whereas the Upper Midwest got the second half, "pop."

Her other concern involved aquatic plants. "I hate the water lilies because they always get stuck in the propeller." Closer to the truth is the fact that they do much to sop up phosphorous that would otherwise make the lake murky and provide critical habitat for many creatures.

On the plus side, Wendy was glad to live in Hackensack because it lies in the heart of Minnesota lake country. Attitude is everything. Some of the folks I know back east would consider this a "hick," town, not a "hack," one. They would be wrong.

As I was leaving town, I walked over to photograph the water tower, below which a little league baseball game was being played. On the way, I saw a sign posted in a window, advertising the price to lease a building. It was forty-two cents per square foot per month. That may sound low to most readers, but I suspect it sound like zero to my son

who works in real estate finance and leasing.

It being late, we made no further stops before Lake Plantagenet, where my parents have a family cabin.

Day 12 – Home Town Bemidji

One would think that after 11 days on the road, and having arrived at home, I would sleep in fairly late. Not so. I woke at 5:00 AM, just in time for a crisp clear sunrise, which I documented with a series of three photos.

Sunrise of July 10, beginning at 5:30 AM local time. The photo above and the two below it were taken from the family place on Walleye Drive at Lake Plantagenet.

Thorson family cabin on Lake Plantagenet, Hubbard County, Minnesota, a few miles south of Bemidji. Photo taken in mottled sunlight at 8:30 AM.

George Gackle's cabin had been built from plans identical to the cabin my parents live in during the summer. George is my archetype for the tens of thousands of Twin Cities residents who drive north for summer weekends to experience lake life. Because he wasn't around that weekend, I was able to use the picnic table on his screen porch for my morning writing sessions.

It was quite cool on the porch that morning. Wearing only a light coat, I was quite comfortable for the first hour before 6:00 AM. But during the second, however, my fingers got too work without periodically warming them up, and shakes and shivers began to run through my body. The previous night, temperatures had fallen to somewhere in the low fifties or high forties, making the densely shaded porch too cold to work comfortably, even in the middle of July. The following day the newspaper reported a low of 42 degrees Fahrenheit.

This was indeed a continental climate. Most of the groundwater recharge happens in spring, when snowmelt takes place and when moisture from the Gulf of Mexico makes it up this far north. I the summer, evaporation dominates on the clear-sky days. Transpiration from the leaves of trees follows a very strong diurnal rhythm.

John Deere

My dad was the first one down, wearing his John Deere pajamas. For those of you who don't know, John Deere is a brand of tractor revered by Midwesterners. The roots of that company can be found in Worcester, Massachusetts, which became the center of manufacturing for farm products after the shift toward mechanization began in the mid 19th century, several generations before either of my Scandinavian great grandfathers immigrated.

Dad isn't a farmer. In fact, my Norwegian grandfather was a bit circumspect when he first laid eyes on the skinny guy courting Margaret, the oldest of his children. In terms of family relations, my Dad had four strikes against him, being a Swede from Fertile who was studying music education at the University of North Dakota.

To an outsider, the cultural differences between Norwegian and Swedish immigrants was more exaggerated than real, not unlike the differences between baseball rivalries, for example the Red Sox and the Yankees back east, or the Twins and the White Sox in the upper Midwest. On the second point, Fertile was then – and remains today –a small agricultural village on the eastern edge of Glacial Lake Agassiz. This is a lake that used to be, the largest lake geologists have been able to document on any planet at any time. It was created when the outlet of the Great Lakes near the Upper Peninsula, Michigan was dammed by the retreating ice sheet, which had pressed the crust down with its weight. A fairly shallow, but extremely wide glacial lake from Wisconsin to near the Mackenzie Delta in the Yukon Territory was the result. Any farmer from the inland hills of North Dakota at that time would have been envious of the stone-free, rich soil of Fertile. On the third and fourth points of concern, studying music at the university was not my grandfather's idea of what a man was supposed to do.

Of course, everything worked out fine, or I wouldn't be here at the lake with my parents who've been married for more than sixty years.

For two full summers, I drove a John Deere tractor on the family Dakota homestead. On my best days, I worked from breakfast to supper by steering the tractor up and down the fields, pulling whatever needed pulling: the cultivator, the swatter (which cut grain and put it into windrows), the stone boat (used to skid boulders to the edge of the field, or the sprayer.

It's the last point that's of concern today. Chemicals applied to farm fields remain one of the most pernicious problems facing American agriculture. I confess to have played an unwitting role in this damage. I remember going into the shed, grabbing the heavy five gallon cans of something called 2, 4-D, pouring five gallon cans of concentrated chemistry into the five hundred gallon tank, and spraying a mist on seedling plants. The results weren't just death by chemistry for insects or weeds. The biological consequences ripped upward through the whole food chain.

The Course of Civilizations

After breakfast with my family, my godfather, uncle Keith, relayed an old Twin Cities joke he learned when was attending the University of Minnesota. Here's how it goes. One resident of Minneapolis tells another "Better Flush. Saint Paul needs water!" Minneapolis has the good fortune to be on the upstream side. This fact is of significance for all cities that share the same water supply.

Invariably, there's a historical trajectory of conflict. Here are the stages. Stage 1: No Euro-Americans have settled yet. The river is close to its natural state because the indigenous peoples had neither the desire nor the technology to change rivers very much. Stage 2: Settlement begins at or near the mouth of the river, its downstream limit. A city dependent on the river for navigation and irrigation is born. Stage 3: Settlement continues upstream, sometimes far upstream, new cities are born on riverbanks, and farms cover the watershed. Stage 4: Civil engineers and chemical corporations wreak havoc throughout the watershed for private gain. Stage 5: Everything is negatively impacted in a cascade from top to bottom. At the top are places like Lake Itasca, headwaters of the Mississippi River. The bottom is the spreading dead zone in the Gulf of Mexico, killed by a lack of oxygen in bottom waters ultimately caused by too much agricultural fertilizers spread on the land.

Lake Plantagenet, where I sit this morning on a large rustic porch overlooking the water drains through the Schoolcraft River to join the Mississippi River about seven miles to the north.

Mississippi River at its northernmost point, Bemidji, Minnesota. From here, the river flows into the lake, is transformed by lake processes, and then different water flows out the other side.

Indeed, the river flows to Bemidji, the first city to send its liquid message to New Orleans, a world away to the south. And though beautiful, the Schoolcraft River is already polluted with nutrient, causing algal blooms when conditions are right, and a slight aroma of soil plus fish.

Remember the fatal bridge collapse in Minneapolis on interstate 35W a few years ago. While the nations attention was riveted on the tragedy, I noticed that the salvage work was hampered by the gray-green turbidity of the water, caused by soil erosion and too much algae in the water.

Long Lived Professors

The final stop of the day was planned months ago. I was scheduled to give a public lecture on my new book, *Beyond Walden* sponsored by the College of Liberal Arts and Sciences. My talk was in Sattgast Hall in the very same room I heard my first college lecture.

Sattgast Hall, Bemidji State University, on the lake.

The topic was introductory geology, the year 1969, and the professor was James Elwell. Forty years had elapsed without any form of communication. Now we were in the same room. I was here to thank and honor him for the role he played in taking a kid that barely made it out of high school and setting him on a course toward a career in science, rather than toward military service in Viet Nam. He had come as part of the audience, to honor his former student simply by attending. July 9 was indeed a day for the family history books.

These limnology facilities are part of Bemidji State University. They are improved, relative to when I attended there from 1969-1973.

Americans are living longer. Three other former professors were there as well. All played an equal role in setting me straight. Adelle Elwell taught me biochemistry and anatomy, and is now running a science education center in downtown Bemidji. Hal Borchers was my professor for Invertebrate Zoology. He actually looked up my grades before coming to the lecture, having kept such records his whole career. He let the audience know I'd done just fine. Robert Baker taught me ecology and conservation, subjects that have stuck with me more closely than the others.

Wall of fish in the Harold Peters Aquatic Laboratory, Bemidji State University.

A highlight for me was to hear my little brother sing one line from an old Willie Nelson song: "Momma's don't let your babies grow up to be cowboys." Eric is a much better musician than me, and does a great Willie Nelson imitation, even when asked unexpectedly to sing without warning from the center of an audience. That line is to accompany a side that shows me as a child with a cartoon callout containing a historic, mid-19th century image of Charles Whittlesey, America's first glacial geologist.

Charles Whittlesey, courtesy of the Wisconsin Historical Society.

In the carefully staged studio photo typical of the day, he looks just like an authentic cowboy, with a large felt hat, tough outdoor clothes, and boots. A closer look, however, reveals a rock in one hand and a rock hammer in the other, rather than a rope and a pistol. Indeed, I did not grow up to be a cowboy. I'm a geologist who writes.

The lecture was over and the day was done.

Day 13 – Mississippi Headwaters

Today's water adventures were to the historic headwaters of the Mississippi, which lie south of Bemidji, and to the most northerly headwaters, which flow through the Turtle River. More specifically, we went south to Itasca State Park, and north to Concordia Language Villages.

Recipe for a Clean Lake

To reach Itasca, we followed county gravel roods on the Schoolcraft Trail south toward Lake George. Out of nowhere appeared the boat launch for Evergreen Lake.

Evergreen Lake, Hubbard County, Minnesota.

There wasn't a sound. No boat, no swimmer, no breeze. The water was crystal clear for many reasons that were plainly visible from here. Change one and it will begin the inevitable progression toward murkiness, turbidity, and stench.

Being a kettle lake in the middle of the forest, there is little runoff from the land. Thus, it's spring-fed from the vast sand and gravel aquifer beneath the lakes country of north-central Minnesota. In turn, the aquifer is recharged with cold snowmelt and rainfall.

With no agriculture, recent forest clearing, and only one cabin on its shore, there is little phosphorous entering the system. Finally, the dense rim of vegetation surrounding protected bays, sops up most of the nutrient present, preventing algal growth.

Water Facts

Itasca State Park wins the price for the most effective water resource education. They put them in the washrooms, above the urinals, in the sit-down stalls, above the sink, and next to the hand driers.

Sign in the stall of the men's bathroom at Itasca State Park, Minnesota.

Each is presented in the form of a question and answer. Here are two examples, quoted directly "Q: Where does the water come from that we use in the park? A: It comes through ells dug deep down in the artesian aquifers. The aquifers, which were formed by glacial drift or glacial outwash, are two to 50 feet thick. Q: Did you know that the land

you camp on and the lake where you fish or swim are directly linked? A: They are linked by wetlands such as marshes and bogs, through which rain and spring waters flow as they make their way to the lake."

Park Bench Interviews

Now that the trip is half way done, I'm getting pretty savvy at selecting targets to interview. Benches are the best. The odds are that anyone sitting on a bench is either resting or waiting, and therefore in no hurry to get up and leave.

Settlers Cabin at Itasca, built by CCC workers. Note that only four logs are used to raise the roof.

My first victim caught me off guard. Colleen, a math professor from Bemidji State, comes to Itasca quite often for its naturalness and beauty. When I began my pitch, she caught me off guard by informing me that she already knew it, having heard my lecture the day before. That explained why she was vaguely familiar, and why she had such a quick answer. "You can drink it." That was her comment about water on the plus side. Indeed, this is more important than anything other aspect of water, it meets or metabolic needs.

On the down side, she reported that many countries in the world, especially the poor and developing nations in Africa, Asia, and North and South America no longer have access to potable water from streams and wells, due to pollution and excess demand. This sets the stage for the commercialization of water sold in plastic bottles.

What's in her head is not what's' in Chris's head. He was in Itasca for its latitude and longitude, a convenient and nice place for his wife to meet – for the first time – a "friend"

she had met on the Internet. On the ups and downs of freshwater, his answer had a literary flair, whether he knew it or not. He said he was from Mobridge, South Dakota, which lies on the banks of the Missouri River. When the river is up, everyone is happy, the marinas have plenty of business, and the recreational boating fishing, hunting, and swimming are wonderful. When the river is down, the water is murkier and nearly stagnant, and its edge can be as much as 300 yards from the docks of the marinas. Businesses go broke and people leave. This is what's been happening lately, a trend caused by drought but exacerbated by the ongoing recession. Unlike Colleen's metabolic and global views of water, his were ultra-local and related to the importance of water in controlling demographic and economic trends.

Tour boat leaving from Douglas Lodge at Itasca State Park.

Ollie and Virginia were from the town of Moose Lake, Minnesota, which actually abuts Moosehead Lake, which is fed by the Moosehorn River. They were sitting outside Douglas Lodge, a delightful log building built by the Civilian Conservation Corps during the 1930s. I guessed they were in their mid seventies and had been married for at least half that long. "No," Ollie said, "we're engaged." At that point Virginia held up he diamond ring. Ollie, who was quick with an opinion on everything, said that getting married was an economic necessity, but did not elaborate. I suspect this might have been the case, because they actually got into an argument about water even as I was interviewing them. He insists that she drink bottled water because Moose Lake city water has added chlorine, fluoride, and other stuff he doesn't know about. She accommodates his request some of the times, but prefers to drink straight from the tap, perhaps because it's recently been shown that the plastic bottles release synthetic hydrocarbons into the water.

Dock at Douglas Lodge, Lake Itasca, Minnesota.

This lovely historic inn at the southeastern limit of Lake Itasca, may be the first source of pollution on the Mississippi River, sending molecules to it that eventually reach the Gulf of Mexico. Note the well camouflaged drain pipe leading into the lake, which probably carries treated wastewater from the lodge.

Pink lady slippers at Itasca State Park.

I loved Virginia's response to the plus side of freshwater: "We have a deep well and a tall tower." Indeed, the deeper it is, the less likely it is to be contaminated by surface and near-surface pollution, for example LUST, short for "Leaking Underground Storage Tanks," a serious problem in many urban and suburban areas, especially from home heating fuel tanks and gasoline stations. She didn't have a negative comment.

Ollie sure did. He was hopping mad at the University of Minnesota Agricultural Extension Service for not giving him a straight answer about a sample of water he had brought in for testing. Having not gotten a satisfactory answer form underlings, he worked his way up to the "top kick," meaning the boss lady. Ollie believed that she thought him to be "a plant from the opposition party." His story brings out something interesting, the politics of water, which will become increasingly challenging in the future.

When I finished these three separate interviews from the same morning in the same place, I couldn't help but think how much they differed.

Delicate Balance

Matt Snyder, the manager of Itasca State Park, is the kind of guy I'd be happy to work for: calm, confident, easy going, open to different ideas, and generous with his time and attention. I very much appreciated his answers to my water questions.

Water education is a big part of the program at Itasca. It's hard to avoid interesting water facts when you have nothing else to do but read. Urinal at the park Visitors Center. Four other plaques are there as well, above the hand drier, near the sink, and ...you guessed it...on the doors of the toilet stalls. This place is a veritable temple to water education.

"I like the clarity of the water." He was referring to the kettle lakes of northern Minnesota in general, and Itasca in particular. This comment was precipitated by his personal comparison with the prairie potholes of South Dakota, which become brown-green with mud-algae as the water table drops during the course of the region's hot dry summer. On the down side, he said that that clarity misleads people. Though it's often said that "what you don't know can't hurt you," this is clearly not the case with water. Crystal clear water can be toxic with transparent dissolved contaminants.

The hardest part of his job was trying to find the right balance between exposing visitors to all aspects of the park, while simultaneously protecting the park from visitors. On some days, he worries that the park will be "Loved to Death."

We the got to talking about the three mega trends in my book *Beyond Walden*: climate change, over-development, and the increasing alienation of children from nature. Itasca is poised to be greatly changed by the end of the century if the predicted scenarios ensue.

Drought will be more common, the water tables lower, the lakes murkier. The beautiful Norway Pines, which bring so many people to the park --especially at Preachers Grove where they are featured –, are not regenerating. Is it the deer? Climate change? Some complex ecological link we don't understand? He doesn't know. Nor do the scientists at the University of Minnesota's field station, which has used the park as a research facility since 1909. I imagine a scene when the stronger windstorms predicted by climate models take down the trees, which cannot regenerate because the same models predict a shift away from pine forest to oak savannah.

The pine trees bring many visitors to Itasca State Park.

He agrees that overdevelopment is a major problem on many lakes. Of special concern to him are the "Mom and Pop" family resorts, which have been an important part of local economies for three generations. They are disappearing, being replaced by "pricey condos" full service resorts owned and run by larger corporations. This leads to our third mutual concern, the reduction in the number of children being exposed to nature. They are doing everything they can at the park to make it family friendly.

Itasca's competition for the attention of children, will soon be a water park at the Red Lake Reservation, part of a massive casino development program I read about this in yesterday's Bemidji Pioneer. When I asked Matt why he thinks the tribe is doing this he said, "To me, they're trying to expand their clientele to family oriented people."

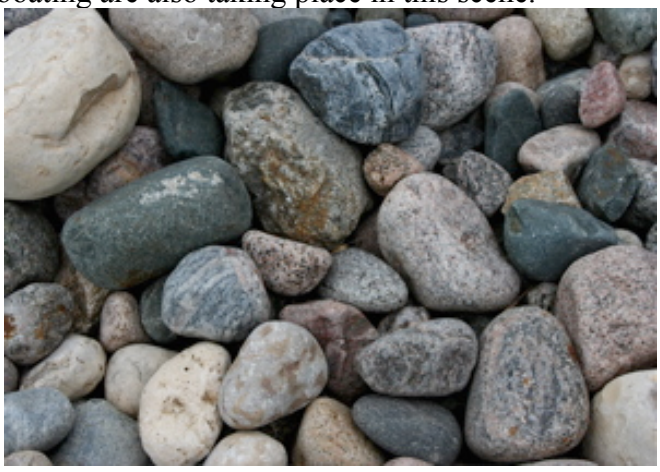
I think that the whole idea of water park in the Land of Ten Thousand Lakes is as absurd as a store selling sand in the Sahara. It might also make economic sense in a world of with unlimited petroleum and no concerns about carbon pollution. In influx of tourists to Red Lake will require thousands of unnecessary car trips to a very remote location. I fear for a future in which economic models do not properly take into account the environmental costs, which we all will share.

A Symbolic Act

I reached the headwaters just in time to snap the photo below. It shows an elderly, cane-wielding gentleman attempting to cross the line of boulders placed across the headwaters of the Mississippi. Perhaps he thought it was a fountain of youth.

Crossing the headwaters of the Mississippi River, which drains northward from Lake Itasca, Minnesota.

Ten seconds later, his cane slipped, he fell, got wet, and gave up, having slipped on rocks coated with slippery algae. Excess algae may be due to nutrient pollution from within the park. I was impressed by this man's initial determination, and by the equanimity of his resignation that his body was no longer quite up to the task. Note that swimming and boating are also taking place in this scene.



Boulders at the headwaters, Itasca State Park, Minnesota.

These boulders, from the Archean age rocks of the Canadian Shield reminded me that all of the water in the world came from vapor steamed out of the early earth when it melted completely. These rocks were among the first to form on earth. Something as delicate as the pink lady slippers we saw earlier exist because of this violent steaming phase of earth history.

A few miles down the road, we found some of that water flowing where it wasn't a tourist destination.

Global Kids

North of Bemidji, and seemingly in the middle of nowhere, a gravel driveway takes off from Beltrami County Road 20. It leads to a cut hayfield, where hundreds of empty cars sit roasting in the sun. They had been parked by visitors to the International Day celebration at Concordia Language Villages, held on July 10. Most of the visitors were here to meet their sons and daughters enrolled in what may be the finest language learning program in the nation.

Students from Concordia Language Villages get together for a rave on International Day.

Clearly, the energy is very high and very happy in this extraordinary place, which was far ahead of its time when founded half a century ago. Teachers and students come from all over the world to attend a summer camp to learn common languages like Spanish and exotic languages like Norwegian, and to make lifelong friendships that will help our homogenized world stay sane in the future.

The geographic nucleus for this whole program is an otherwise humble pair of kettles called the Turtle Lakes, drained by the Turtle River. In the late 18th century, this stream was though to have been the source of the Mississippi. This wasn't a bad guess, for the Itasca is only a few miles longer.

One of my sons is an alumnus of the program: he learned Spanish there. So is my wife Kristine, an English language teacher who attended one of their TESOL (Teaching English to Speakers of Other Languages) programs.

I wondered if the students had to surrender their cell phones when they arrived, and what they might think of the wall phone from Douglas Lodge at Itasca State Park, that was used in the 1930s by members of another good idea, the Civilian Conservation Corps, the CCC.

Phone from Douglas Lodge, Itasca State Park Minnesota.

Leaving our car, we boarded a leased school bus for transport into the language villages. Shortly after exiting, we met David (pronounced "Dahh veed" with an accent on the second syllable) who was dressed in period costume as a 17th century voyageur.

Dah veed' is a French voyageur, a canoe guide, and a language teacher. He poses as a tough guy in this photo.

As part of their French program, he guided a student canoe trip through the Boundary Waters Canoe Area. Some of them were dressed in costume as well; others as members of the Ojibwe tribe with painted faces. David remarked that the best thing about freshwater was the experience of paddling to the middle of a giant lake on a clear day when the surface is absolutely still, then jumping in. Almost as good is lashing two canoes together for stability, using a tarp for a sail, and gliding over the surface of the lake. The worst thing about freshwater was when other canoeists destroy the beaver dams, rather than portaging around them.

In front of the main building was a station illustrating the second half of the student watering system from natural precipitation to human metabolism.

Water station at Concordia Language Village, Turtle River, Minnesota.

The whole system involves, infiltration, aquifer storage, pump, pressurized pipe, spigot, plastic pipe, faucet, bottle, mouth, and esophagus.

Next was a tour of the biohaus, on the site of the German Language Village. In this highly engineered "green" house, water is used for space heating, after being heated with passive solar from a roof panel.

Biohaus at Concordia Language Villages, Turtle River, Minnesota.

Just before catching the bus for our return trip, we spoke with two staff from the program. Steve was from Moorhead College, which has administered the program ever since it was started by one of its faculty. His freshwater "upside" was family fun at the lake, in his case Tomahawk Lake in northern Wisconsin, which we passed a few days ago. His "downside" was the chronic flooding of the Red River of the North, which seriously overtopped its banks last year. His house was OK, but many of his neighbor's houses were not. The Red River is one of the most flood prone in the world because runoff from the clay-rich watershed is high and the river's gradient is so negligible.

Kerstin, another staff member of the language village, liked freshwater swimming because there were no sharks. Her downside was murky water, caused largely by sediment pollution and algae.

Taking the bus back, we sat by Dan and Maggie. They were visiting Dan's daughter, Angie, who was enrolled in the Chinese language program. They were fanatical fisher"men" from the Twin Cities area whose favorite place on earth was Mille Lacs Lake, where the walleye is the only serious game fish.

Dan and Maggie visiting Concordia Language Villages, Turtle River, Minnesota.

They were soon to be married. It's a match made in a here-and-now heaven called Mille Lacs Lake. Note that both have caps from Mille Lacs. He has a Gopher shirt as well, signifying his allegiance to the University of Minnesota sports program.

When I asked them about freshwater, Dan's upside was "multiple species." His downside was invasives. Given the fact that he had a muskie on his screensaver, I figured he was referring to multiple species of fish in a Minnesota lake. Of course, invasives are species as well. His responses essentially boiled down to fish vs. weed, a local example of the familiar dichotomy between animal and vegetable. He also told me

about the ice fishing, and the ice-driving, with multiple plowed roads running every which way.

Maggie's downside was the tendency of Jet Skiers to whiz right by her boat when she's fishing, when they could be anywhere else on this vast lake. How is it that Mille Lacs is so bit, and the other lakes so small. It's a shallow remnant of a much vaster lake that lay inside a kettle moraine. This lake was the size of the ice lobe, whereas the kettles nearby were made from small blocks.

Her upside was Mille Lacs itself. She's been coming here ever since she was a child. Her dad brought her up from the cities on many weekends because he just loved the lake, in spite of his habit of calling it the "Big Black Dead Sea." About to get married, they will likely last, given the fact that the second love for both is fishing on one big lake.

The trip back was much easier than the way there. We arrived back just in time for dinner.

Day 14 - Lake Plantagenet

It was a beautiful morning, perfect for the central Saturday of a weekend family reunion.

Group photo with a few people missing.

Though I had initially planned to take the entire day off, I couldn't resist a short trip over to the public boat dock on the other side of the lake, where the big boat was being put into the water.

Boat Launch

One of the signature events of the annual reunion is for the kids to go water-skiing and tubing (hauled over the water on a disk-shaped canvas raft) on Lake Plantagenet. Because the Thorson boat docked there is only 15 horsepower, we must use my bother Thor's more powerful boat, which is docked at North Long Lake in Brainerd. For a few hours of fun, there are two round-trips for the boat on Long Lake and Plantagenet, and four round-trips for two autos at both lakes.

Matt, an employee of the Minnesota Department of Natural Resources majoring at nearby Bemidji State University, was waiting at the boat launch to check out our boat.

Matt enters data regarding my brother's boat before it can put it into the water, Lake Plantagenet, Minnesota.

He has a summer internship working as a boat launch inspector. He's not there every day, but is rotated to different launches on a schedule set by his supervisors. On many days, he said, there is no inspector there.

Water at boat launch is clear, with a porridge of wave-broken weeds in the swash zone.

His job is to take note whether the boat has a particular sticker, which informs him that the owner of the boat has already had "the lecture" on invasive species. This saves Matt time. Next, he asks several simple questions about the point of origin of the boat, how long it's been out of the water, and where it will go next. This information, when compiled into a large data base for thousands of users, will be used to track the spread of invasive plants, and to inform a study by the University of Minnesota about the habits of recreational boat users.

With respect to the inspections, the main concerns here are milfoil and zebra mussels. There are other management issues as well. The muskie sign is one indicator.

Sign at boat launch, Lake Plantagenet, Minnesota.

It's the apex predator of northern lakes, and therefore the most sought after sport fish in Minnesota.

The fisheries scientists at DNR work with the social scientists to write regulations that try to optimize the balance between sport fishing and long-term stability of the freshwater ecosystem. At the present time, a muskie has to be four feet long before it can be taken from the water. Those are only the largest individuals, the ones that your "manhood" can

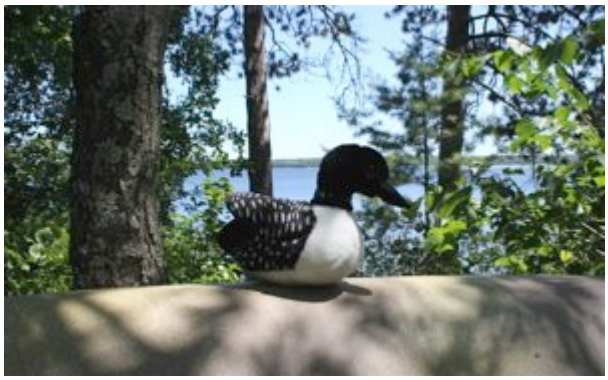
be most seriously tested, presuming that's an issue at all.

He reported that this was a particularly good lake to work on because 70-80% of the residents know about milfoil. In fact, the lake has a strong association composed of shoreline property owners who pay half of Matt's summer salary. That is matched by the state DNR. This is a wonderful model because it puts the onus of care on those who are, or will be, most affected, a good example of think locally, act locally. Of course the lake associations need the help of the much stronger state agency, which takes the broader view. So far on the trip, this is my first point of contact with a government agency responsible for overseeing and regulating lake activities.

Matt ties with Robert – from Costello's Bar in Saint Paul -- for the shortest responses to both my questions. Matt is having fun; even if his principal job is to manage what he likes the least about Minnesota Lakes. No doubt he will have a successful future in wildlife management, his major.

Clara de Loon

When we were at Walden Pond nearly two weeks earlier, Kristine felt that we needed a traveling companion who wouldn't be too much trouble. In the Shop at Walden Pond, which is run by the Thoreau Society, we bought a toy loon being marketed by the National Audubon Society. When squeezed just right, it emits the familiar cry of the loon.



We presume that Clara appreciated the chance to sit around looking at the lake, playing Bocce Ball, and taking a boat ride, in this and the next two photos.

After leaving Walden Pond, we decided that her name was to be Claire, named after the Debussy piece "Claire de Lune." We would call her Clara. Having a loon from Walden Pond travel to Minnesota makes sense because Thoreau was very enamored with this species, and because the common loon is Minnesota's state bird. Real-life loons on Plantagenet have been making wonderful music for three days now.

From here on, the day was limited to family activities. The food never stopped and the beer flowed freely. News was shared, lawn games were played, and jigsaw puzzles were put together. The lake beckoned with a refreshing swim for me, boat rides for the seniors, power-tubing for the kids, and the annual "girls water conference," during which three grown women spent a few hours talking safely out of reach of men while anchored on an inflatable raft.

The rest of the day didn't involve water at all. Thorson family reunions always involve guy talk in the garage, where my dad hangs out.

Leif, Thor, and Jim Thorson, were doing woodwork during the reunion.

Thor the muscle man

Pickup trucks capable of hauling a large boat or trailer are the vehicles of choice for many Minnesotans.

There's always a private concert among us. I played the wood block and was featured during one solo. Others are far more talented.

Kimberly, Eric, and Uncle Keith.

I was asleep by 11 PM. I heard that the party lasted past 1:00.

Day 15 – Lake Union

Sunday was a day goodbyes, following the 15-hour picnic of the day before. Kristine and I didn't leave for our planned day trip to Erskine until after 3:00 PM. Our destination was the original family cabin on Union Lake, which my grandfather, Theodore W. Thorson, bought in 1928 for $500.

Cottage at Lake Union, Erskine, Minnesota, has been in the family since 1928, and is about the size of many modern garages.

Lake Union is where the taproot of family lake culture was planted in my father, who

spent his summers there during the Great Depression of the 1930s. One generation later, Lake Union was also the place I learned lake culture at a child during the 1950s and 1960s.

A family lake in Minnesota doesn't have be much of a lake. It merely has to be big enough to have game fish for grown-ups -- northerns, walleyes, and bass – and smaller, fish for children – sunfish, perch, and crappies. It must have water blue enough to offset the chromatic monotony of seasonal green for summer, fall for autumn, and white for winter that is so characteristic of the northern glaciated plains. I must have some topographic relied to offset the topographic monotony of flat sand plains and the undulating surface over which the glacier glided. The water must be warm enough to swim in, and the lake surface broad enough to experience the adrenaline-pumping fun of traveling at fast speed in a motorboat.

Leaving Bemidji, I took a photo that captured two elements of water management. The water tower was new and solid, providing a guarantee of fresh water, even if the pumps or electricity failed during some catastrophe. And below the water tower, in a new housing development was a rain garden.

Water tower and rain garden in Bemidji, Minnesota.

This isn't a garden in the traditional sense. Rather, it's a steep-sided hollow into which surface storm drainage is routed via culverts. Water that might otherwise run off rooftops and pavements into streams and then lakes is instead stored temporarily on the surface for as long as it takes to infiltrate into the adjacent sand and gravel. This traps surface pollutants, reduces lake turbidity, enhances groundwater flow, offers herbaceous habitat to suburban wildlife, and provides a nice visual contrast the monotony of perfect green lawns.

Wheat was in the late 19th century, and remains now, the lifeblood of agriculture near Erskine, Minnesota, an archetype town at the edge of the prairie in northwestern Minnesota.

Wheat in Erskine, Minnesota.

Dryland farming has always been a risky business on the northern plains, where drought, hail, locusts, and late spring planting threaten crops. Three of these four threats directly involve freshwater.

This farming village itself lies within a chaotic kettle moraine that gave rise to rolling farm country speckled with small kettle lakes and dominated by sandy loam soils. Only a few miles to the west are ancient beaches of Glacial Lake Agassiz, the largest lake known to have existed on earth. The bottom of that former shallow lake gave rise to some of the flattest topography and richest silt and clay loams in the nation. This was the original breadbasket of the upper Midwest, now being planted with corn for ethanol, canola for oil, and soybeans principally for livestock feed.

My father was born in Fertile, Minnesota, which is aptly named. It lies on the pool-table flat bed of lake Agassiz, whose major port city was Fargo. My favorite story about this glacial lake is the one told by Garrison Keillor in *Lake Wobegon Days* (1985). The first Norwegians settling in Wobegon migrated in from the west, having gone out there in search of a large lake they knew to have existed, but which had drained about 12,000 years earlier.

Each summer the Thorson family of the baby boom joined the countercurrent of immigration to head east into lake country. This story, and what it means, is told in the chapter on family lake culture in *Beyond Walden*, which contains more memoir than history, literature, or science.

The Hanson boathouse on the western shore of Union Lake, Erskine, Minnesota.

To the south, the shoreline of Union on July 12, 2009 looks nearly the same as I remember it as a child during the baby boom, with the only conspicuous difference being a docked jet ski, an invention that had not yet been invented. They do little harm in deep water. In shallow water, however, the powerful jets suspend settled lake-bottom muck up into the water, which greatly increases the transfer of nutrient and the problems that follow. To the north, however, the shoreline looks completely different. What used to be forest above a biologically rich bay has been converted to capacious lawns, large year-round houses, and a boulder-lined shore. This story was told in the July-August issue of *Natural History Magazine,* published by the American Museum of *Natural History*.

Erskine's big fish, which I remember climbing around on as a child

In July 2009, the water surface of Lake Union stood about three feet higher than the

previous year, owing to a thick late winter snow pack and drenching spring rains. In fairly flat country such as this, the level of small kettle lakes is controlled entirely by the elevation of the water table, which always reflects the net balance of inputs and outputs. The inputs are precipitation that infiltrated below the soil to the continuously saturated zone. The outputs involve evaporation from the lake, transpiration by plants, water pumped away for human uses (agriculture and domestic), and that which drains away in the aquifer. With spring-fed lakes such as this, a higher water level usually translates into a cleaner, more enjoyable recreational lake. Hence, water conservation at the surface makes sense -- even in a place with abundant fresh water -- because the quality is controlled by the quantity.

Low spot in field near Erskine, Minnesota was not plowed because it was too wet during spring planting.

For decades, the downtown park in Erskine, Minnesota has featured a large cement statue of a northern pike, the locally favorite game fish. On U.S. Highway 2 just to the west a large billboard advertisement reads “Worlds Largest Northern.” It is not clear whether the sign refers to a live catch or to the cement statue.

Cyclists Dave and Heather, resting in the park pavilion in Erskine, Minnesota.

Dave and Heather were in the process of pedaling a tandem bike between Lewiston, Montana and Atwater, Ohio when we met them. Like us, they were approximately half way through their road trip. Their blog is at www.bikerbeans.blogspot.com.

It took them two days to cover what we did in an hour. And I thought we were moving slowly.

Water tower in Fosston, Minnesota stands above the local John Deere dealer.

This image says much about the needs of small town Midwesterners, water and equipment.

Day 16 – Lake Wobegon

Today was departure day from Lake Plantagenet for the rest of our trip. After four nights with family in northern Minnesota, we were rested enough to set off in search of Lake Wobegon, which lies somewhere in the center of the state, probably in Stearns County. The search turned out to be so interesting that we fell far, far short of our goal of ending somewhere in South Dakota. Instead, we crashed at my cousin's home in Richmond.

John and Carol Fjelsta's home on Horseshoe Lake, in Richmond Township, Minnesota.

Leaving the cabin at Lake Plantagenet, we stopped to gas up a few miles away at Kabekona Corner. Sally, the attendant Sally had become intrigued by our Connecticut plates, inquiring where we were from. This has always been a difficult question for us because, at present, we split our time between northeastern Connecticut and Conanicut Island in the state of Rhode Island. Before that, we've had a complex history of moves compounded by three year-long sabbaticals.

When Sally found out that we had an Alaskan connection, she told her story about being "called," to Saint Lawrence Island, which has absolutely nothing to do with French Canada. Instead, it lies off the west coast of Alaska within the windswept Bering Sea on what used to be the Bering Land Bridge. This ice age the pathway, now drowned by the sea of the continental shelf, was used by the antecedents of the American Indians more than 12,000 years ago, whether they came overland on the tundra or skirted its edge using watercraft.

Sally's favorite thought about freshwater was that "in spring, you can smell the snow melting and hear the water trickling underground." Though I doubt it's possible to hear infiltration through the vadose zone, at least I had found someone who understands groundwater recharge.

Lake Death

Lakes are places where sediment accumulates but cannot easily escape. This is true for both the inorganic materials like sand and silt that wash off the land and organic materials that are created within the water by aquatic plants.

Small pond just north of 11th Crow Wing Lake, Minnesota, being filled largely the accumulation of aquatic plant remains.

Given enough time every lake whose basin is not actively being enlarged by tectonic stretching or ground subsidence will eventually shallow and fill completely. Lakes usually go through stages of marsh or bog before finally dying as swamps in the east and fens in the west. Lakes can also disappear when the water table drops.

Thinking about this inevitability should help us appreciate the lakes that we have. Nutrient pollution is causing them to fill up much faster than normal.

Paul's Birthplace

Akeley, Minnesota claims to be the birthplace of Paul Bunyan. This is largely due to the a logger named William Laughead (1882-1958), who lived in Akeley between1900 to 1908 during the peak of the timber trade. Allegedly, his stories, especially the one inventing Babe the Blue Ox, made Paul a legend after they were gathered into book form. At least this is what the sign says out front of the gas station located next to facsimile storefronts form the logging-era.

Highway humor at gas station in Akeley, Minnesota, built for fun and to attract road-weary tourists.

This allegation could very well be true. According to historians, Paul Bunyan was invented on July 24, 1910, when journalist James McGillivray published a piece of pure fiction in the Detroit News Tribune. Because Laughead had already left Akeley by then, a local birthplace of the legend there is a distinct possibility.

To environmental scientists, LUST is an acronym for Leaking Underground Storage Tanks. These are a very serious problem for groundwater contamination, because the fluids – gasoline, oil, additives like EDTA, or worse – leak down to the water table, usually float on its surface, and are carried down gradient as contaminant plumes.

It's far better to have them above ground where leaks are far less likely because there is less corrosion, and they can be spotted much easier. Another advantage of above ground tanks is that they can also be made into folk-art reindeer.

Herd of Oil-tank Reindeer pulling Santa's sleigh just north of Akeley, Minnesota.

I excluded Santa from the photo because he was weather-beaten beyond recognition. Just upslope from the reindeer is a good example of water pollution.

Surface pollution below gas station just north of Akeley, Minnesota.

Runoff from the pavement and adjacent compacted soil erodes a channel, which adds sediment to the car-related pollutants and nutrients being conveyed to the pond in the distance. The water there is full of green scum and presumably invisible toxics.

Highway 64

Poplar is a township that seems to lack a village center. It's also the common name for trees of the genus *Populus,* more commonly known as aspen. These fast-growing trees were often logged off for pulpwood used to make paper products. Lumbering around here was a boom-bust business, peaking in the first few decades of the 20th century.

Abandoned building along Route 64 in Poplar, Minnesota.

The building, which sits isolated, looks like a one-room schoolhouse, complete with outhouse. The handicap-accessible ramp to the left, the steel door, and the curtains on the windows suggest it was later used as a residence. Now it is home to swifts, which have built dozens of mud nests between the porch overhang and the front wall.

As the name of the township suggests, the logging economy preceded the recreational tourist economy, setting the stage for its rapid spread in the mid 20th century.

Smoked Fish

My taste for smoked fish probably started at Morey's.

Morey's Fishouse in Motley, Minnesota.

Long before I was a resident of Minnesota, my parents made an annual summer trip to the family cottage on Lake Union, with kids crawling all over the station wagon, as was then the custom. Their trip took them through Motley, so they made a habit of stopping at Morey's when it was then a fairly small operation. Now the company exports its smoked fish all over the world.

Smoked Canadian whitefish in the sales case of Morey's Fish House in Motley, Minnesota.

Interestingly, it imports its whitefish from Canada, because those in the state have been largely fished out. In fact, my buddy and I used to net and smoke them when we were in college.

At Morey's, I had a chance to visit with Julie Mertens, the head fishmonger (manager of the store). "The fresher the water," she said, "the better tasting is the fish...and the less polluted it is, the better they are for you." This I would take a general rule for practically everything we eat or drink.

She then went on with a lament about people disrespecting water. Her story was about a recent vacation to a coastal beach in Mexico, which was trashed by those who partied on the shore all night long. When she got up on the first morning of her vacation, she found so much trash that she had to find some bags and clear the beach before she could enjoy it.

South of Motley, we turned south on Route 1. Crossing the Elk River, we noted that it looked like a stagnant sludge canal covered with duckweed. This was not a good sign for nearing Wobegon.

Linked Landscapes

Todd and Stearns County Minnesota contain two landscapes. The dominant one is a gently undulating topography created when the moving ice sheet smeared glacially ground-up sediment to the land surface. The resulting soils hold water well, contain

mineral nutrients, and have enough clay to be fertile. Hence, they are covered with productive farms growing soybeans, corn, grain crops, and hay for livestock. This provides the most important part of the economy, farm products for export.

Spray irrigation just east of Browerville, Minnesota.

Barely visible between the wheels in the foreground is a tractor hauling a sprayer filled with something other than water, perhaps liquid ammonia for fertilizer, an herbicide, or an insecticide. The problem with this kind of agriculture is commercial viability requires the addition of chemicals that pollute the groundwater and stream systems. Fertilizer provides the nutrients that plants need for lush and productive growth, generally phosphorous and nitrogen in water-soluble forms. Any that escapes to aquifers or as surface runoff will eventually reach streams and lakes, causing excess growth of aquatic plants, principally algae and "weeds."

The other landscape type consists of kettle moraines, which were built at the edges of former glacial lobes. Sand, gravel, boulders, lakes, and bumpy topography are the result. Because agriculture is generally restricted to haying and woodcutting, the economy is

dependent largely on lake recreation.

Ochotto Lake, just north of Avon, Minnesota.

The pesticides and herbicides that reach lakes don't stimulate plant growth, but change lake and stream ecosystems in ways that are poorly understood. Another problem is that many of these toxins such as lead, mercury, and persistent organic pollutants bio-accumulate up the food chain into fish, which are often eaten by humans, creating a public health hazard.

In Long Prairie, we stopped at the Dairy Queen to interview a local resident. There we found Jody, the manager, who was willing to share her stories. She drinks water from her groundwater well at home, avoiding city water due to "that smell," referring to the chlorine odor that comes from the treatment plant. "You have to take it on faith," she commented, "that they know what they re doing," meaning the municipal water companies. She's especially concerned about babies getting chemicals so early. "Water is a resource we should never take for granted." Her water highlight of the year is an annual family vacation to "Lake of the Woods," a Lake Agassiz remnant above the triple border between Minnesota, Ontario, and Manitoba.

Perhaps we can't win. Our wells can be polluted through agriculture. The city water puts in things you may not want, such as chlorine and fluoride, bottled water is a concern

owing to the seepage of plastic residues, and the hard plastic water bottles of polycarbonate lose molecules into the water as well.

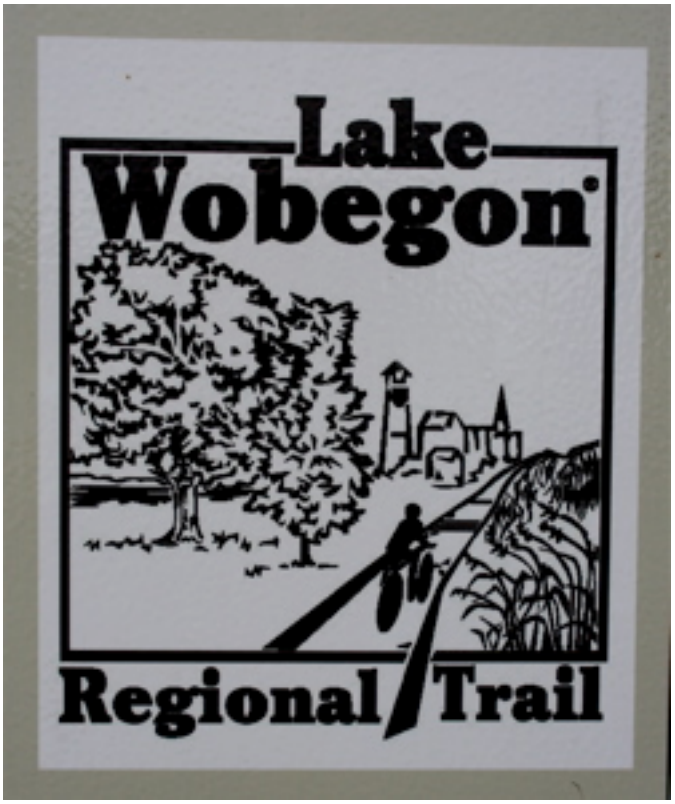
Main Street

Sinclair Lewis was the first American to win the Nobel Prize for literature. He grew up in a small town on the edge of the prairie named Sauk Center, which is nestled against the shore of Sauk Lake. The tallest architectural achievement is the water tower, followed by the grain elevators and church steeples. The novel he set in Sauk Centre, Main Street, was a national blockbuster that has since become part of our cultural and literary canon. Within the novel are conversations within cafés, homes, churches, stories about lake life, and the conflict between New England pretensions and Minnesota realities.

When researching that novel and the biography of "Red' Lewis, I was struck by the similarity between the settings of Lewis's novel *Main Street* and Garrison Keillor's novel, *Lake Wobegon Days*. I was equally struck by the similarity of their biographies. Though the purposes of the novelists were vastly different, their settings -- and in a few cases the descriptions of the settings -- are nearly identical. Both are small lakeside towns at the edge of the prairie in the headwaters of the Salk River watershed, which drains to the Mississippi.

In 2001, Keillor suggested in passing that Holdingford, Minnesota was most "Wobegonic" of all. After looking at a map of Holdingford, I couldn't understand this statement because everyone knows that Lake Wobegon's Main Street is nestled against the namesake lake. So, when writing my recent book, *Beyond Walden*, I suggested that nearby Avon, Minnesota was a better fit.

Hence, our search for the wide main street of Lake Wobegon took us to Main Street in Sauk Centre, main street in Holdingford, and main street in Avon in chronological sequence from 1920, 1985, and 2009. All three towns are located on the Lake Wobegon Regional Trail, where "all the visitors are above average."



Sign for the "rails-to-trails" Wobegon Trail, Sauk Centre, Minnesota.

Except for the plastic on the signs and the auto styles, Main Street looks similar to what it was in the first few decades of the 20th century.

Main Street in Sauk Centre, Minnesota.

This is especially true of the cafe for the Palmer Hotel, which figured prominently in

Main Street, a predecessor for Garrision Keillor's "Chatterbox Cafe."

A predecessor for the Chatterbox Cafe.

Tastes in dress and music have certainly changed. Several of the teenagers walking buy were dressed in hip-hop style, with oversized short pulled down to show underpants, and with chains and rapper caps turned sideways. The public signs are also bilingual, with English and Spanish.

When writing *Beyond Walden*, I tried to find out what Sinclair Lewis majored in when he graduated from Yale in 1909. I didn't find this information in Lingeman's authoritative biography, nor anywhere on Yale's alumni website. So I asked the librarian in Sauk Centre, who didn't know but referred me to the local history museum, who didn't know either. Perhaps one of my readers knows and will contact me.

The town of Sauk Centre abuts Sauk Lake, which is regulated by a dam at its junction with the Sauk River. As I approached the lake, I could see its green color, that of algae growing because of too much nutrient. As I walked toward the river, the smell of decomposing algae was powerful. One look at the falls below the dam, confirmed my suspicion that the nutrient laden water is very eutrophic, the term scientists use to describe a lake that’s too rich in nutrient.

Boys fishing at the head of the Sauk River in Sauk Centre, Minnesota. From left to right they are Dylan, Jay, Matthew, and Jack. The oldest was in 7th grade, the youngest in 3rd.

One look at the water pooled up below the dam in eddies made me wonder why anyone would tolerate such pollution.

Polluted water below the dam at Sauk Lake, Sauk Centre, Minnesota.

I asked the boys if they could smell the water going over the dam. "Oh yeah," one of the

boys replied, it "doesn't smell too good." When I asked them why, they said that it stunk because it was polluted. Nevertheless, they eat the fish they catch, despite knowing if they've been tested and what might be found. They even fish in the winter, because the river here never freezes, even though the lake above it does.

Of course, if you want to make the lakes and rivers clear, you can stop adding nutrient to it. Unfortunately, this would ruin the agricultural economy. Alternatively, you could add chlorine which kills bacteria an algae, and which is cheap, but comes at the price of frightening many people away from drinking it bacteria and algae that would otherwise grow.

Art above pool in Sinclair Lewis Park in Sauk Centre, Minnesota.

The clarity of swimming pools and ponds is accomplished by the killing of microbes but not the people who use the water.

Holdingford

If Holdingford is the model for the mythical town of Lake Wobegon, then a revision of the architectural pecking order I needed. The water tower, grain elevator, and church steeples, still rank from highest to lowest in terms of elevation. But today, the cell phone tower looms over them all.

Entering Holdingford from the west. Cell phone tower is barely visible to the right of the sign. The water tower and church steeple are clearer.

My how things change. The "little town that time forgot" must now be full of young people texting each other for hours a day.

The landscape around Holdingford is productive and tidy. So are the homes and churches. Then why, I wondered, was the downtown so small and so dominated by bars and liquor stores? Country music was blaring from one of the storefronts. I noticed two Catholic churches but no place for Lutherans.

Downtown Holdingford, Minnesota.

The engraved sign where the Lake Wobegon Trail crosses Route 17 has it right. Holdingford is not the town of Lake Wobegon, but the gateway to it.

Sign on Route 17 entering Holdingford, Minnesota from the west where it crosses the Wobegon Trail.

Avon

Holdingford is the gateway to Wobegon, not a stand in. That place is Avon, which lies a few miles south on Route 9. Approaching it, we found the familiar bumpy, boulder, and lake-dotted terrain with trees here and there. The large productive fields surrounding

Holdingford have given way to more “Wobegonic” pasture and hayfield. And most importantly, downtown is nestled against Middle Spunk Lake.

Downtown Avon, Minesota looks quite Wobegonic to me.

The mural on the wall of a Laundromat summed up the setting in ways that a photograph could not.

Laundromat in downtown Avon, Minnesota.

Since leaving Walden Pond in Concord, Massachusetts, I’ve been looking forward to the symbolic act of pouring water from Walden into it. The place we chose was the boat launch, just off town.

Boat launch on Middle Spunk Lake in Avon, Minnesota. The public swimming beach is barely visible on the opposite shore.

Of course, I filtered the water first, so as to serve as good model for preventing the transport of invasive species. (One of the most important is the zebra mussel, whose larvae are microscopic.)

My bottle of filtered Walden water is empty. Location is the fishing pier in Avon, Minnesota.

It was a great moment, witnessed by Clara de Loon who, when squeezed, gave her familiar cry of loon delight.

Jamie, who was 14 and Sawyer, aged 13, had followed us to the boat launch from downtown, perhaps because they had seen the first Connecticut plates in their life. Neither had ever heard of either Walden Pond or its most famous resident, Henry David Thoreau. Hence, watching a grown man pour water into their lake from a lab bottle must have been a source of amusement, something to text one another about.

The boys were of like mind on the ups and downs of freshwater. There was "lots of fishing" to be done, which is getting harder because of the "weeds," by which they meant the invasive Eurasian milfoil. ONe of them mentioned “jiggers,” which is local-speak a skin rash believed to be caused by goose poop.

Having poured water from Walden to Wobegon, my plan was to return the favor by reversing the process. This required collecting a sample.

Collecting water from Middle Spunk Lake to pour into Walden Pond, to complete the water exchange.

Just as we were about to leave, we met two lifetime residents, Eric and Holly, who were 21 and 20 years old, respectively, were walking down during what looked like a lover's stroll. Neither had ever heard of Thoreau or Walden Pond. When I put my questions to them, Eric responded immediately. "Obviously, you gotta love fresh water because you can go fishin' on it." Holly provided the down side of water. "You get jiggers," she said. These, she believed, were invisible parasites that are released into the water by goose crap, and which you get when you go swimming. I believe she was referring to the schistasome that give rise to swimmer's itch.

Then they reversed roles. Eric said that "if you live too close the lakes, you get all kinds of bugs," meaning mosquitoes and flies. She countered with the something positive, "having a good time at the lake...you know...swimming, boating, and such.

While getting into our car, Larry and Harley, two thirty-something adults, motored up in their boat after some time spent fishing. While they were trailering their boat for the road, I asked Larry if he had ever heard of Walden Pond. "No, but I have heard of Walden Woods." "Walden Woods," was the name given to a project that saved a forested

tract in Concord north of Walden Pond from development as a suburban office park. Its chief sponsor was rock star Don Henly, who got involved and provided most of the funding.

This is the only case I am aware of when a famous celebrity adopted a kettle pond as a cause. I suspect it was the link between rock star and a pond, rather than the link between the Transcendentalist philosopher and the pond, that jogged Larry's memory. This deduction was confirmed for me when I asked him if he was aware of any other famous person connected to that distant place. "Yeah," he responded, "a guy named Henry James Thoreau. I think he wrote 'Leaves of Grass.'" I didn't have the heart to correct him about Thoreau's middle name, but I did let Larry know that it w was Walt Whitman who had written that wonderful long collection of poems. His fishing buddy, Harly said "No" twice when I asked him the same questions.

Larry, who must have been a family man, likes fresh water "for swimming...kids and what not." His concern was that lakes "get dirty easy," because the "rivers and creeks are polluted." He was especially worried about blue green algae in Little Rock Lake, in the nearby town of Rice.

Just before dark, we took a tour of Big Spunk Lake, which lies just across the other side of the freeway. This edge of town is beginning to look less Wobegonic, given the expensive houses we found along its shore.

Formal entry to an expensive beach house on Big Spunk Lake, Minnesota, made of local boulders from the moraine.

Our final stop of the day was at the public boat launch at Upper Spunk. Unfortunately, someone had tipped over a Port-a-Potty.

Tipped toilet at the public boat launch at Big Spunk Lake, Minnesota.

This could have been an accident, my guess is that some young person was inside using the toilet when one or more people pushed it over as a prank. Did the contents leak?

Our work done, we wandered down to Richmond to spend the night with my cousin John, who had been expecting us for lunch about seven hours earlier. The lake landscape there is a delightful chaos of islands, isthmuses, and peninsulas to most people. We saw it as a chance to get lost. We drove around for at least half an hour trying to find John's place before we nestled in for the night.

Day 17 – Continental Divide

Leaving New England for the upper Midwest took us from a place where they call lakes "ponds" to one where they call a lakes "lakes." By the time we got to Aberdeen, South Dakota, the vast majority of lakes were being called "potholes." Go figure.

Leaving Lake Country

Cousin John lives on the south shore of a large conglomeration of lakes that had been connected when a dam was raised to create a flowage. The main inlet stream to the system was the Sauk River, which we noted the day before had been seriously polluted upstream. Hence, the lake is "eutrophic." In local parlance, this means it's full of algae and weedy. Scientifically, it means a lake with elevated biological productivity which, in turn, is caused by excess nutrient, either phosphorous or nitrogen, whichever is limiting. Eutrophic lakes usually have a greenish brown tinge caused by a mixture of the plant pigment, Chlorophyll-a and suspended clay. Their fish fauna is catfish and carp in extreme cases, or bass, pinfish, and pike in normal cases.

John prefers trout. Though he lives on a lake and has a nice boat, he goes fishing in Watab Lake about ten miles to the north. Trout can survive there because the lake lies in a kettle moraine, a bumpy, sandy, woodsy place where grain agriculture is difficult, and where the inlet streams are tiny, meaning the lake is mostly spring fed. It's also a deep lake, largely because the ice block that melted to produce it was thick. This means that it is colder than normal, which means that fishermen who prefer trout will drive miles to get there.

Another thing that makes John's lake eutrophic is it's archaic drainage system. When driving away for South Dakota, we noticed a decades-old road drain that funneled water from the farm above us directly into the lake between two cottages.

Drain above Horseshoe Lake, Richmond Township, Minnesota

A Touch of Scandinavia

From Richmond, our route took us west along Route 9, then north along Route 55 to Lake Minnewaska, then west on Route 18. Along part of the way there were dozens of nice lakes because we had been following the Glacial Lakes State Trail, which traces the crest of a kettle moraine through west central Minnesota. Heading west into the semi-prairie, I followed the route taken by thousands of late-arriving Scandinavian immigrants, who, having found the Minneapolis area filled up, headed west toward South Dakota.

Part of the Glacial Ridge State Trail on Route 18, headed for Morris, Minnesota.

Defeated by a muddy gravel road, we jugged north for the town of Starbuck, located on

the shore of Lake Minnewaska. When driving in, we noticed a sign on the beach warning ice fishermen to have their shacks off the ice by March 1. No doubt they will have to replace the sign in the future, as the long-term trend is toward thinner ice forming later and melting off earlier. In fact, the boundary of those lakes that break up on a specific date (such as March 1) is moving north at the rate of 6-12 miles per year.

This rate is broadly parallel to migration of dates for other phonological phenomenon such as the flowering of plants and the arrival of migrating birds, which are well described in the literature.

Another thing we saw at the town beach in Starbuck were more than a hundred piles of weeds, probably milfoil, raked up on the beach but not yet removed. We saw no swimmers at all, but were not sure why. This we found out at Tom's Food Pride, the local grocery store. There the Pope County newspaper carried a front-page story about swimmer's itch. Our cashier, whose name I forgot to get, said that locally, it was really bad. She had seen customers that had it "really bad, like poison ivy." Continuing, she remarked, "nothing clears a beach faster than swimmer's itch." People still swim, but to do so they have to head out for deeper water and jump in from their boat.

Here, the kids were blond, the churches were Lutheran, and the elderly housing was managed by Lutherans. I don't recall seeing any other denominations represented.

Historic railroad station in Starbuck, Minnesota, with sign for world's largest lefse.

The claim to fame for Starbuck was the world's largest Lefse, created on July 1, 1983. Not quite perfectly circular, it measured 9 feet 8 inches by 7 feet 1 inch in diameter. This is huge for a lefse because it takes great skill to roll it out. My largest – I make lefse every year for Christmas -- never exceeded about 15 inches across because I make it in my biggest cast iron skillet. In effect, lefse is a Norwegian tortilla, made out of potatoes that are mashed, mixed with just enough white flour to hold it together, and with some

butter, salt, and cream.

Lefse in grocery store case at Tom's Food Pride, a "pretty good" grocery in Starbuck, Minnesota.

Move over tortillas! If you find lefse in the grocery store case, then you know you haven't quite reached the west.

We wondered if we could get lefse for lunch at Vincent's Starbuck Café just down the street. The waitress was reading a newspaper at the counter, because there were hardly any customers. A group of four was having coffee near the front. John and Irene, an elderly couple, a retired farmer and his wife, were having coffee and splitting a large chocolate chip cookie at a nearby table.

Morning coffee in the Vincent Starbuck Café, Starbuck, Minnesota. Clockwise from left, Irene, Janet, Ray, and John.

I asked them if they would be willing to answer my questions. They invited me to sit down. John said the best thing about freshwater is his own well, which is "soft as rainwater," meaning it doesn't have a high concentration of dissolved solids. They had to go down 319 feet through "two levels of granite" to get enough good water. On the

down side, John said that there is “no such thing as freshwater anymore. It’s all those fertilizers, he said, and the other stuff farmers put on their crops.” John admitted that he had spent nearly a lifetime putting that “crap” on the fields, knowing that it was tainting the water. Now, I believe, he wishes that there had been a better way.

They were meeting another couple for their morning coffee, apparently a daily ritual. Ray, who retired after being in the grain business for 36 years (someone has to operate those grain elevators), came in first. As he settled, John told me a story about a flowing well to the north that, when first tested, had enough “gas coming up light a blue flame.” This is the natural gas, generally methane, which “is down there somewhere.”

Ray’s downside of freshwater were the flowing wells to the south that had nothing but rusty water, which ran brown out of the ground, and which were no good for drinking. Irene, John’s wife, was miffed at the new water tower in town. When they switched over from the old one, she said, the “water wasn’t as good as before. It’s just yucky.” Janet offered that the water from Russell Springs was just “awful.”

These were folks from a very settled farm culture. All four had separate stories about water from wells. Here they were on the shore of the largest lake in this southwestern Minnesota kettle moraine, one that resembles a fat version of the Finger Lakes of New York state, and not one mentioned the lake. That is a different culture, a recreational lake culture. How different was their worldview from that of the Fjelstas who we had left scarcely an hour before.

Working our way westward, we entered the small farm town of Cyrus, Minnesota, with a population of 303 souls. There, we found the first purely western icon on the trip, at the Lariat Bar and Grill.

The Lariat Bar and Grill in Cyrus, Minnesota.

A lariat, for those of you who don't know, is a rope made out of braided leather and used for managing livestock.

Genes, Chemicals, and Ethanol

The large print on the billboard between Chokio and Morris, Minnesota advertised 300-bushel corn, an astonishing yield per acre.

Billboard between Chokio and Morris Minnesota advertising farm products sold by Monsanto, Corporation.

The fine print carried the name of Monsanto Corporation LLC, a giant chemical corporation that sells fertilizers, death chemicals, and genetically engineered seeds to large commercial farms. It's also the target for many environmental groups who see it as one of the greatest contributors to the degradation of our water quality, a point with which I thoroughly agree.

I don't know what the theoretical limit is for the corn genome is in terms of yield. But I do know one thing. That limit will be set by the amount of fertilizer sprayed or spread on the fields.

Tanks for liquid fertilizer in Chokio, Minnesota.

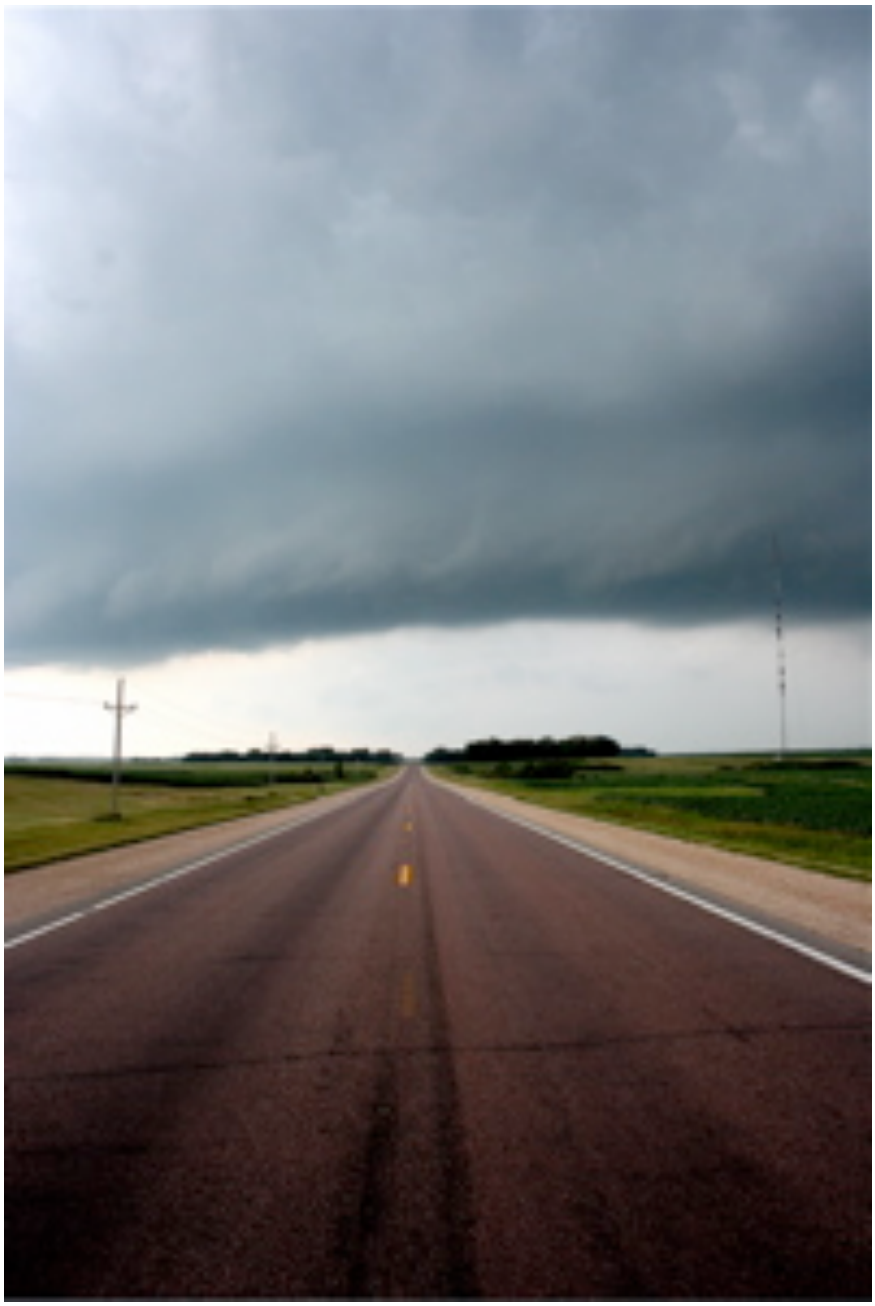
Around here, the nitrogen is applied in the form of anhydrous ammonia. By-products of this application are nitrates and nitrite contaminants in drinking water and bacterial toxins like botulism and salmonella caused by eutrophication. The combination of this billboard and the nearby tanks illustrates clearly that big business is in the business of pressuring farmers to get more and more out of their privately owned land. But at what cost to the public streams and aquifers?

And the purpose of that corn? To create livestock feed for our meat habit and ethanol for use as a liquid fuel in our automobiles. And the purpose of ethanol? To achieve energy independence on the supply side of our economy, rather than on the demand side. Though I don't have the specifics on hand, I understand that economists have demonstrated that there is a net loss when the energy costs of producing ethanol are subtracted from the energy it releases. Regardless of the energy economy, the political economy favors home-grown fuels, regardless of the environmental damage.

Ethanol is big business here. We saw at least two new ethanol refineries, no doubt propped up by federal tax incentives. When we filled up a few miles down the road near Langford, South Dakota, the fuel pumps offered three different concentrations of ethanol, the normal E-10, which is ten percent, E-55, and E-85. The farmer there, who produced corn for ethanol, was filling up with E-10. That only makes sense because producing ethanol costs more in terms of energy than it produces.

Big Sky

Driving across this "Big Sky Country" in the afternoon was very interesting. Our county road was arrow-straight and laid out perfectly west by the compass. Rapidly moving thunderstorms are common in midsummer, given the high humidity, the flat landscape and the constant wind.



A developing thunderstorm near Morris, Minnesota.

We'd skirt the edge of one, plough through another, go below a high one, and watch the majority race away. For a full hour this was our visual entertainment. Here, the sky was the dominant aspect of earth. In the mountains, it may be the rock, in the wet tropics the multi-tiered forest, and in lake country the lakes. But here it was, without question, the sky.

Directly opposite each other were two windmills. To the south, probably on the campus of the University of Minnesota Morris, was a wind turbine from the 21st century.

Wind turbine in Morris, Minnesota on a muggy afternoon.

How lonely it was, I thought, in a place where there was room for a wind farm of 100,000 just like it. All day, the wind had been blowing. How much energy had moved by untapped? On the other side of the road was the more traditional windmill, now derelict.

Old windmill, no longer being used, Morris, Minnesota.

A century ago it pumped water up from the aquifer, probably to supply the house,

livestock tank, and garden irrigation. Now, with it's tail full of buckshot holes, it stood derelict. If windmills could talk, I wondered, what would the old one say to the new?

Continental Divide

There is a place where South Dakota is both north and south of Minnesota. I refer to a triangular patch of the Gopher State that indents the Mount Rushmore State. This cartography reflects a spectacular geological event in the history of North America that has to do with the continental divide.

Browns Valley, Minnesota is a small town in North America's biggest coulee, one of dozens of many broadly notched valleys present throughout the high plains and the upper Midwest.

Big Stone Lake, at the Minnesota-South Dakota Border west of Morris, Minnesota, occupies the largest coulee in the United States.

Coulee is a French word meaning "to flow." Each was cut by the north-to-south overflow of glacial meltwater lakes from the area presently draining to Hudson Bay to the area presently draining to the Missouri-Mississippi-Ohio system. When they formed, a large, but shrinking ice sheet covered most of Canada, blocking flow to the St. Lawrence, and forcing flow to the south.

The most spectacular of these coulees carried Glacial River Warren, which carried the flow of Glacial Lake Agassiz, nether of which currently exist. Today, the big river is silent, instead occupied by two ribbon shaped lakes impounded as water supply reservoirs. Big Stone Lake drains south to the Gulf of Mexico via Mississippi River.

Lake Traverse drains north to Hudson Bay via the Red River. We stood at a continental divide far more important in terms of U.S. History than the one crossed by Lewis & Clark out west.

Lake Traverse, at the Minnesota-South Dakota Border just northwest of Browns Valley, Minnesota.

Between them is the town of Browns Valley, a fertile, but wet, alluvial lowland now traversed by a lazy stream notched several hundred feet below the generally flat but undulating topography on either side. This boundary between Minnesota and South Dakota is the cultural boundary between east and west. Very few folks, especially back east, consider the Land of 10,000 lakes as a western state. Yet those same folks likely consider the Mount Rushmore state, with its endless prairie and enormous Indian Reservations to be a thoroughly western state.

During the first decade of family television in the 1950s and early 1960s, Hamm's Beer had one of the most successful television commercials I remember. The commercial featured a happy black bear as the star, and a catchy, Native American-themed lyric that said with a pow-wow beat: “From the Land of Sky Blue Waters.”

Tavern sign in Brown's Valley, Minnesota

This, of course, referred to Minnesota. Now the sign says, “born in the land of sky blue waters,” probably because, in our age of globalization, it’s no longer from the state.

I've always had an issue with that phrase because the sky is never nearly as dark blue or as azure colored as fresh clean water. Why? Because it is only a coincidence that the nitrogen and oxygen in the air scatter the some of the same blue wavelengths as the hydrogen and oxygen in the water. The phrase "from the land of water-blue skies." Both would be equally incorrect.

Prairie Potholes

The “couteau” was clearly visible from the west side of the coulee at Big Stone Lake. A couteau is a ridge, in this case an east- and north-east facing escarpment several hundred feet high, underlain by sedimentary rocks of the high plains. We climbed it steadily, stopping for a backwards view toward Minnesota at an observation tower. Beneath the tower were three Native Americans of the Lake Traverse tribe, on whose reservation we were now driving.

The top of the couteau was very different country. Pure prairie, with just a few patches of trees in protected sites. Angus beef were grazing in every which direction.

First treeless prairie of the trip on the Couteau des Prairie above Lake Traverse, South Dakota.

The most astonishing thing we saw in the next twenty miles were hundreds of blue potholes, each a small kettle lake or pond. When the Laurentide Ice Sheet ran into the couteau, it was forced to compress. This forced gigatons of sediment per square mile up onto stagnant masses of ice. When the sediment-buried ice melted, it left a chaotic landscape of hills and hollows called ice stagnation terrain.

Depressions that intersected the water table or were lined with clay became potholes, forming a population of small lakes numbering in the tens of thousands between here and Montana. Others formed when the glaciers tore up a patch of earth; still others are simply low spots on impermeable soil. They are uncounted. Most are unnamed.

The larger bodies of water, perhaps above ten acres, are considered lakes.

Prairie pothole in the Overberg Wildlife Protection Area, east of Buffalo Lakes, South Dakota.

Potholes do not occur everywhere, but in bands from about ten miles wide to more than a hundred. They are critical habitat for the flyway of migrating waterfowl that pass overhead.

The dominant resident waterfowl are the pelicans. We saw no gulls or herons. It must also be good habitat for turtles, because we saw nearly a dozen crossing the road within our last fifty miles.

The trees returned as we reached the depression of Buffalo Lakes, east of Eden, South Dakota. They are too large to remain unnamed.

South Buffalo Lake, South Dakota.

The road curved back and forth through the Buffalo Lakes, which were too large for bridges or causeways. This was not the case to the west, where the ultra-straight road called 122nd Street, cut through nearly a dozen small potholes on causeways.

Pothole filled with crushed rock to allow the road to continue in a straight line.

Apparently a curve around the lake was not a consideration when the road was built, probably before wetland protection laws became common in the mid 1970s. Every pothole we saw, regardless of size, had some white water on its surface, the work of waves. I can only imagine how much moisture is being evaporated today, and whether the potholes could last the summer.

Our final stop in pothole country was at Fort Sisseton, built soon after the Great Sioux Uprising of 1862 in southern Minnesota. It would be a bulkhead in the Indian wars to come, which culminated with the genocide at Wounded Knee in 1890.

The high ridge on which the fort was built is part of a moraine, which held sufficient boulders and timber for construction. More important was nearby Kettle Lake, which held a strategically reliable supply of potable water.

One of many stone barracks completed in 1864 at Fort Sisseton, South Dakota.

Road to Aberdeen

We stopped for gas at Langford, a small town northeast of Aberdeen, and our destination for the night. While pumping, I talked with Ron, a sixty-something local farmer covered with soil from head to foot. His positive comment about freshwater was that you "don't really have to worry much about the stuff they put on the fields. It's not as near as ad as that the 'big city folks' put in" waterways and on the soil out east. Clearly he was a westerner. Clearly, he preferred to overlook the damage being caused the farm chemicals he was applying

His concern was that a pipeline was coming and that the industry might compromise water in some way. Then he talked about NIMBY, short for "not in my backyard." Everyone wants fuel, he said, but nobody wants a facility where they live.

I've worked on jobs involving pipeline is before. When in college, I was a maintenance employee for Great Lakes Gas Transmission Supply out of Bay City Michigan. As a geologist in Alaska, I worked out of the pipeline camps studying the natural hazards of the route through the Brooks Range. In Saugus, Massachusetts, I helped inventory the

historic archaeology through the suburbs of north Boston. Compared to these three settings, a pipeline trough the immense flatlands of South Dakota would be a piece of cake in terms of its historic and environmental impact.

Apparently, a major pipeline is being constructed to bring oil from the foothills of the Rocky Mountains, probably the tar sands of Alberta and the newly developed oil from the Williston Basin in North Dakota. Some of the residents of South Dakota are up in arms over the environmental damage that would be caused by the pipeline. Ron wasn't worried at all, since things were so much simpler here than in Alaska, where the oil pipeline faced much more challenging engineering conditions. However, just because a pipeline here is easier, doesn't mean that it has minimal impact.

Soon, we were crossing unglaciated country of black prairie soil. Here the problem is not soil fertility, as is the case of the hay country on kettle moraines, but water. This is a land where the balance between too much and too little is razor thin. Apparently, they had had plenty of rain, because shallow flooding killed vast areas of planted crops. On the other hand, the wind was dry and blowing steadily. I got to thinking about how much evaporation there must be under such conditions.

Areas of mud caused by sediment washing from plowed fields and by standing water. Photo to the north of 130th Street west of Pierpoint, South Dakota.

Our second to the last stop of the day was doubly sad. Just before turning south on County Road 37, we drove by an enormous feedlot full of grimy dark brown sheep that should have been white.

Mutton feed lot on 130th Street east of Aberdeen, South Dakota.

All were mired in manure and what soil scientists call a mollisol, the formal name for the black earth soil so common in this country. Hundreds of sheep were standing, eating, and milling about in a place without a single blade of grass. Down slope in two directions were bodies of standing water filled with feedlot runoff, destined to ruin some downstream river.

The saddest part was the looks of resignation on the face of the sheep. They bleated weakly. The could hardly move. This was a factory farm of the worst kind. Inhumane would be a nice word to describe this travesty of arrogance over the feelings of animals. I have nothing against eating mutton or any other kind of meat, provided that the animals are respected before slaughter. Not so in this case.

Our final stop was the James River in flood. A turtle was crossing the road, one of dozens we had seen along the route through pothole country.

James River near flood stage near Aberdeen, South Dakota. Dark spots are swallows upset by my presence on "their" bridge.

This James River is significant for two reasons. Though it appears fairly small and only slightly lower than the rest of the landscape, in this country it was big enough to guide a glacial lobe far to the south. Secondly, it is on the banks of the James River, the same stream that cuts through the homestead settled in 1892 by my grandfather hundreds of miles to the north.

In Aberdeen we had trouble finding a place to stay. The Super 8 offered free beer, so we decided to find a quieter spot. Most of the other franchise motels were full, and have been for more than a month, owing to pipeline construction. Clearly, there's still big money to be found in fossil energy these days. One would never guess that the carbon age is nearly over.

Day 18 – Twin Dakotas

Waking up in Aberdeen, South Dakota convinced us that we had left one culture behind and found another.

Hitch'n Post clothing and gift shop in Aberdeen, South Dakota.

The West

Only one day earlier, we looked out the window at breakfast to see recreational lake, rimmed with year-round and seasonal homes. The wallpaper stencils, the paintings, and the dust collectors had themes involving fish, pine trees, loons, and bears. From this point on the bait shops would be replaced by tack shops for riders. Paul Bunyan had given way to the cowboy. The bases of lamps were made from snakeskin boots, rather than fishing lures. Loon worship is gone. Pheasant worship has arrived.

In a local retail store, the Hitch'n Post, the clerk refused to speak with me, thinking I was some kind of government spy. It must have been my beard. I learned this by asking another clerk.

On the way out of town, we decided that Aberdeen would be nice place to return for a longer visit, when time permitted. On our way out of town, we photographed the Brown County Courthouse.

Brown County Courthouse in downtown Aberdeen, South Dakota.

Of course the flag was flying because the wind hasn't stopped since we got to the state. Such lovely historic architecture was found in public buildings all over. Private ones were typically flat-fronted wood buildings facing the street or massive square brick buildings. Ranch houses were more common too.

At the tack shop, the counter clerk Shelia said she loved the wind because it kept down the mosquitoes. This was the gist of her response to my question asking for a freshwater concern. More specifically, she remarked that "Aberdeen was built on a slough," adding that "mosquitoes should be our state bird." To keep the town from being a buzzing, bloodsucking nightmare, they spray weekly in the low water spots. I had trouble believing there were any wet spots left, given the steady evaporating wind. On the bright side, she liked freshwater because it was "refreshing." By that, she meant you could jump into it and cool down.

I have one other comment about Sheila. The night before, my editor at the Hartford, Courant -- where I publish a regular Op-Ed column – advised me to get both first and last names from every source. To their standards, a first name was equivalent to that of an anonymous source, which the newspaper doesn't allow. That evening, I became a bit

worried, because, I had been asking for first names only, on the premise that the responses would be given less often and would be more guarded.

Then, on my first encounter after this warning, I did an experiment by asking Sheila for her last name. She refused. Had I chosen to meet the standard for reporting of the Courant, I would have completely missed the water story about the slough and the spraying. I decided that I would continue to use first names only, except for those I encountered I public facilities.

Twin Dakotas

Driving north on State Highway 281 was uneventful, largely because the road ran as straight as a taught string. In Oceola Township, the highest hills were the only hills, piles of sand and gravel being mined for some purpose.

Just beyond the tiny town of Frederick, the road made a slight curve to the west, the first in many miles. I knew from my map that we were now exactly two miles from the North Dakota border. Had the wind been at our backs, we could have sailed all the way into town. Instead it was against us, cutting our mileage by a significant amount. Perhaps we will gain it back when we head back east.

Historic boundary marker at the South Dakota-North Dakota state line.

The main point of the boundary marker was to point out that North and South Dakota were created as twin states out of one territory. I reflected on the fact that I was a twin as

well, born in the same year as my brother James Perry Thorson, whose middle name is that of my grandfather, son of an immigrant Norwegian farmer who homesteaded in Wells County, more than a hundred miles to the north, giving me a Dakota connection for life.

A welcome sign greeted us on the north side of the border. Looking back, I didn't' see one welcoming visitors to South Dakota, though I may have missed it. Looking back was an experiment designed to confirm whether the state officially welcomes visitors on its county roads. When entering the state, I found no welcome sign at all where we entered at Lake Traverse.

We continued north on a straight line. Just south of Ellendale, the first town in North Dakota, Kristine gasped at the city skyline ahead of is.

The skyscrapers of Ellendale, North Dakota are grain elevators.

With so much space, people have no need to go vertical with their buildings. But the grain elevators must go vertical because they rely on gravity to send the grain to waiting railroad cars. Almost without exception, grain elevators signal the presence of railroad tracks. Indeed, without the farms, there would be no railroads and with no railroads, no large commercial farms. The grain elevators are the link between these seemingly separate spheres.

When we drove by the siding, I thought of Grand Central Station in New York City, where I had been exactly one month before for a meeting regarding national water research and policy. I had taken the Metro North commuter train in from New Haven, Connecticut, changed to an underground shuttle at Grand Central, then took the E line north past Columbia University to City College, New York. What a different world that

is.

In New York City, especially on Manhattan, there is a crush of people and the price for commercial and rental properties is as high as its skyscrapers, which is why they are there in the first place. In Ellendale, half the buildings were boarded up, and the streets were eerily silent. Given a choice between city and country, I'll take Ellendale any day. The gas was selling for $2.42 per gallon.

To left of the road were patches of white where puddles used to be. This was unmistakable evidence of salt in the soil, concentrated to a visible powder by evaporation. The air is cooler here than to the east because of that. It sops up nearly 80 kilocalories of heat for each gram of water turned into vapor.

Crossing the Glacier Margin

At Edgeley, we turned west following State Highway 13 all the way to the edge of the Missouri River. At Kulm, Fedonia, and Lehr it jogs south before the home stretch between Wishek and Linton.

Edgeley is fairly flat country, rendered even flatter by the ice sheet that, at one time, slid overhead at a speed of a few yards of tens of yards per year. The load of ground-up rocks and gouged out clay being carried in the lower levels of the ice were pasted to the surface as till, giving rise to productive farm fields.

Just short of Kulm, however, we began to climb a broad ridge, with crops giving way to rangeland. Looking at the map, I realized that the ridge was a couteau, in this case unnamed, and much more distinct to the south. Part way up, we discovered a row of eight dead threshing machines from an earlier, and presumably better era. How they got there is a mystery. Certainly it involved a change from a crop-based to a grazing-based local economy.

At the top of the ridge was a long row of wind turbines producing electrical power for the North Dakota Wind Energy Center. That was the sign posted on the hurricane fencing around a small enclosure no more than about 30 feet square. Inside were a few electrical transformers.

"Mon Dieu!" I thought. Apparently, a hundred or so enormous turbines spread out in a line on the ridge needed no more than a tiny electrical station, less than a tenth the size of those we see once in a while along a typical transmission line. Leaving the station was a single wire. Wind, when measured against the concentrated power of fossil fuels, doesn't have a chance, even here where the wind blows steadily.

The terrain changed on the west side of the ridge. We would cross more than thirty miles of bumpy, bouldery, grazing land dotted with blue potholes. Here and there were elliptical piles about the size of a two-car garage consisting of rounded boulders. This was a broad moraine, a belt of ice stagnation topography where debris thrust up onto the ice by compression against the ridge melted down in a chaotic fashion, leaving potholes where lumps of ice used to be.

Green prairie, blue potholes, and multi-colored horses in grazing county of the ice stagnation terrain near Kulm, North Dakota.

In one field was a row of eight dead threshers, each the size of a truck. These machines were used to separate the grain from its chaff from crops fed into its conveyor belt. They extinct when combines arrived as did typewriters when word processing on personal computers arrived. A combine is a self-propelled thresher that picks up the grain directly from the field. On the trip, I probably saw more than a hundred of these machines, arranged in ways that suggest prairie folk art.

This is great pasture country because the chaotic landscape created microclimates of shade, wind, and sun responsible for a great variety of growing conditions for grass at the scale of acres. Part of that chaos are thousands of water-filled potholes, which provide water for thirsty livestock and also contribute to a variable plant growth, a complete gradient from truly aquatic plants to the bunch grass characteristic of steppes.

The wind was strong everywhere. The grass billowed in waves moving along at a speed I estimated to be a steady twenty-five miles an hour. Small protected potholes remained a deep bright blue. Water from the larger potholes was blue at a distance, but, closer up, had been churned into a light brown color by the suspension of mud into the water, except for the whitecaps.

Strong winds all day from the west (left to right) raised the water level in this pothole enough to flood the road near Lehr, North Dakota.

Some of that mud came from erosion at the edge. Boulders exposed there indicated that the hills were composed of glacial sediment dropped on top of the ice in ages long gone. Another source of mud were small landslides, which opened up holes in the grass to expose brown earth.

With so much water, I wondered why we had yet to see a rowboat, a dock, sailboats, or any sign of lake culture. Water here was used for livestock, and doubled as resting places for migrating waterfowl.

We found Leo at Lehr. When we pulled off the road to grab a sandwich, we found this eighty-something man riding a John Deere lawn tractor, and dressed in a cap, coat, heavy overalls, and probably additional layers below that. Leo ran the only commercial roadside enterprise, a combination gas station (two old fashioned pumps), general store, the predecessor of today's convenience store, but with a dirt pavement instead of asphalt. He was of Russian extraction, the child of immigrants from Old World Tortina. Most of the immigrants around here were Germans and Russians, he said. The Swedes gave it a try, but left.

His positive comment about fresh water was "I like fresh water." He had nothing more to say on the subject. His concern was that the water has too much alkali in it, meaning it is hard and tastes funny. He drinks the town water, which is pumped up from a well and treated with chorine, but doesn't like it much.

He remarked that this country was better off with it's thousands of potholes because they gave the livestock, principally Angus beef, a place to drink. In the old days, a few of them dried up completely. That was "before the snow started to fall." Perhaps this comment was an exaggeration of a real trend. Snowmelt is indeed the main recharge source to aquifers around here.

Down the road we saw a sign for Green Lake Boating and Camping. That must be a big pothole, I thought. It was the first sign of lake recreation since Buffalo Lakes, South Dakota, which seemed a world away.

Beyond the Moraine

We found our first polluted pothole just short of Wishek, covered with floating aquatics and duckweed. Just up hill was a manure-trodden ground feed area draining right to the pond. Just up the hill was the first herd of dairy cattle, in this case Holsteins, we'd seen for more than two hundred miles. There were feeding stations made out of old tractor tires. Boulders were very concentrated on the heavily trampled surface.

The connections were clear. Nutrition brought in from outside in the form of feed allows cattle to concentrate the boulders through trampling compaction and surface erosion. This concentrates the manure, which concentrates nutrient in the pond, which fosters the growth of algae.

We saw a sign on the edge of Wishek: "Sauerkraut Capital." This supports what Leo had to say about the settlement history, dominated by ethnic Germans.

What made me stop was the snowplow on the train, a modern-day reminder of the historic images of trains plowing there way through blizzards.

Bright yellow snowplow attached to a train in Wishek, North Dakota.

Apparently, this still happens. I tried to imagine the scene in which the train gets through faster than any emergency vehicle. The real reason for the plow, however, was the drifting caused by the wind. In winter this is a desert, combination Sahara and Antarctic, with subzero snow blowing about by the wind into huge drifts that must be cleared.

To get a good shot of the snowplow, I entered a junkyard so old that one section had cars from the early 1950s.

Junkyard for 1950s cars in Wishek, North Dakota.

I didn't see a spot of chrome left. All that chromium, a toxic heavy metal in its aquatic form, has entered the soil and probably the groundwater. Junkyards continue to be chronic sources of water pollution today. Of course, there were also rusty barrels. God knows what they once contained. For all I knew, I was on a hazardous waste site.

West of Wishek was a different world. We could see clay at the surface and the local relief was lower, but the land was still covered with glacial boulders. The glaciers overrode this land, but didn't do much to it at all and it was quite long ago, before the last invasion by the ice. If potholes were originally present, which I doubt, they have been long since filled by local mud. This was a largely non-glacial landscape with minor buttes; stream dissected slopes, and a broadly terraced valley. This indicates the long-term work of rivers, rather than glaciers. Still, the boulders remained. One field alone had about 20 piles.

On the low terraces above Beaver Creek we saw the first many dikes on our trip. These were overgrown with brush, and with control structures made of stone. Most looked abandoned, as if from an ancient civilization before the age of concrete.

We turned north at Linton on North Dakota Route 1804. There, we encountered a sign for the Lewis and Clark Trail, the most scenic part of the trip.

North Dakota Highway 1804 follows the route of Lewis and Clark to Bismarck, North Dakota.

Decision in Linton

This town looked neither eastern nor western, but something in between. On the far side of town Kristine noticed a sign that read "Vote Yes for Better Water." Sensing a good water story, we pulled over for a photo.

Billboard in Linton, North Dakota urging residents to approve a plan by the Regional Water District.

Behind us was a guy with a green T-shirt named Bob Job. He was a city employee, out to patch a piece of the sidewalk that had ruptured from subsidence underneath, a common occurrence in fill made of silt-clay and on an artificially steepened bank. Soon after I showed up, three or four others showed up to see what I was up to. When I asked for their photograph, however, they quickly retreated. Bob, being a supervisor, felt obliged to comply with my request.

Bob, a city employee for Linton, North Dakota was my informant on its water decision.

He explained that the "South Central Water District" had put the billboard there. He corrected himself, saying it was officially the "Regional Water District."

Basically, this company sells water to communities from the Missouri River that is gathered more than fifty miles upstream. The regional water district gets bigger by gobbling up the water utilities of small towns. Bigger means more efficient, which means it saves money because each water supplier must meet stringent sampling, analytical, and reporting requirements to the "Feds," by which Bob meant the U.S. Environmental Protection Agency, which is increasing the regulatory burden on small towns and companies to meet the rising concerns about public health.

Linton's water supply is now 5 wells pumped by the city and distributed to customers via

their taps. I'm not sure whether they get a water bill or whether it's paid by taxes.

Additionally, the regional water is better, being "only 6-hard," rather than "35-hard." Here he refers to what geochemists call total hardness, which is largely about calcium, sodium, and magnesium ions.

Linton's choice is to either keep the status quo, or pay more for better water, while at the same time becoming dependent on a distant utility. The converse is to pay less for worse water. The vote, is very close, "50-50" according to Bob.

Lewis and Clark Trail

On the far side of Linton, we turned north on North Dakota 1804, which parallels Lake Oahe, an enormous, ribbon-shaped reservoir of the Missouri River. We had joined the Lewis and Clark Trail. They don't call the Missouri the Big Muddy for nothing.

Water's edge at the boat launch at Oahe, North Dakota. Note that the water is fairly high against the trees.

The Missouri River is full of suspended clay because it drains dinosaur-era shale made of mud that was pressed together solely by the weight of the mud above it.

Outcrop of marine sedimentary rock in Livona, North Dakota, just north of the Oahe boat launch. This isolated remnant of ancient rock is called a butte.

Though more than sixty five million years old, the shale is hardly what one might call rock, for it falls apart easily when soaked by rain and penetrated by plant rootlets. This material was deposited at the bottom of a shallow ocean that extended form the Arctic Ocean to the Gulf of Mexico, isolating the Cordillera as a separate continent. Now, many geological epochs later, that same mud is washing back to the sea via the Missouri, then the Mississippi Rivers.

Sediments above the marine shale are mostly siltstone and mudstones deposited after the dinosaur extinction by broad alluvial rivers. Over the last fifty million years, the land has been uplifted, the interior sea drained, and the mud slivered and sliced into the terrain around here. The creation of landscapes by the removal of what had been there before is a water story unto itself.

Within the last fifteen thousand years, some of the mud being carried was deposited in the winding river bottom as modern sediment called alluvium. Each spring during flood, the river meanders against its bank and re-suspends the mud into the flowing water. Wave erosion does much the same.

Wave erosion at the edge of Lake Oahe, North Dakota erodes the shoreline material and suspends the mud.

Hence, the source of the river's mud today is river mud of geological eras gone by being recycled. In turn, this mud was made by the combination of water, rock, and vegetation during weathering.

The size of the particles making up the mud is small enough such that only minor turbulence is required to keep it suspended in the water. Any sand that would have been present with the mud, has long since settled out.

Here, the U.S. Army Corps of Engineers has a pumping station. It's fully automated, thanks to new equipment, a fancy cabinet that looks like an oversized refrigerator with the door wide open, but with electronics inside, rather than food.

Closet for automatic pumping on the shore of Lake Oahe, North Dakota.

It was a Watertronics-brand automatic water pump, connected to a serious, probably 10 inch pipe heading down into the river.

Water pump at lake Oahe, North Dakota.

Nobody was watching it. Nobody was around. Not one vehicle was in the parking lot. I could have thrown a rock at it and set the government back a few hundred thousand dollars, had I been either a Libertarian or an angry teenager.

Yes, the upper Missouri River is used for its water. There are two major dams. Lake Sacagawea is impounded by the Garrison Dam on its south side, and is so big there is no bridge across it for hundreds of miles. It looks like a flooded stream watershed with V-shaped bays where tributaries used to be.

Lake Oahe is more ribbon shaped, being broad overflow channels for ice age melt. After the ice, it was a fertile lowland alluvial valley in these parts, sacrificed in the name of water. Chad and Tom were apparently pleased, for they came down to launch a boat and go fishing on this enormous, but very windy lake.

Chad and Tom going fishing on Lake Oahe, North Dakota.

As Chad stepped out of his buddy's large white Chevy truck an empty water bottle went skittering uphill, blown by the strong wind. I chased after it, grabbing it ten yards downwind to the east. Of course, no-body would drink the Missouri, which explains the empty bottle. The best thing about freshwater for Chad are the reservoirs of the Missouri, on which he grew up. Hardly a pristine blue pond, they are beautiful in their brown loveliness. His downside was the need to manage water, especially in the drought. He was happy with the Corps for doing what they do. Most environmentalists are not.

Wanting the name of the dam at its south, I traced the snake-like-lake further downstream on my map. I had to change maps, for it extends at least a hundred miles down to the center of South Dakota at Pierre where the Lake Oahe Project dam stands. Near its southern end, Lake Oahe floods not only the channel and the alluvial lowland, but the watershed as well, giving rise to the familiar V-shaped pattern of bays.

Lake Oahe ends just short of Bismarck. Along with Mandan to the west, it straddles a flowing section of the Missouri that extends about fifty miles north before being submerged again beneath lake Sacagawea.

Everywhere you look, there is brown mud, present wherever the grass cover has been disturbed by the digging of badgers, the tires of vehicles have pressed too tightly, where small landslides have left their head scarps, along eroded cliffs, and where water has flowed over the landscape hard enough to cut through the sod.

Without a grass cover, the entire landscape would come part and flow downhill with surface streams as fast as the particles could be released by the soaking and freezing of water in the soil. Badlands are the result, places where rills and ravines have cut down through ancient muddy layers. We saw only tiny ones today. Much larger badlands await us tomorrow.

Below badlands, the mud is either carried away by streams, or is locally deposited. This is exactly what happened on the site of a construction project just south of Bismarck. Construction was associated with the widening and improvement of Route 1804, which we had been following up from Linton to the south. The grass cover had been stripped away, exposing what had been formerly grass covered. Then came heavy rains. The naked soils were too clay-rich to allow rapid infiltration, forcing the water to flow over the surface instead. What had been a smoothly graded surface was cut by millions of rills, thousands of miniature ravines, and a few gashed deep enough to be considered arroyos.

All that sediment was carried into a ditch, which did catch and hold some of the mud.

Failed sediment control in the ditch for Route 1804, south of Bismarck, on the afternoon of July 15, 2009.

Note that the puddle is still draining in the distance. Meanwhile, the surface near the tubes of straw is already cracking from shrinkage caused by evaporation in the windy sunny sun. Note the tube that crosses the channel. The level of mud above and below it is the same, meaning that it did not block sediment. The white blob to the right is the intake for culvert, through which washed lots of mud, trapped on its upstream side. The newer straw tube, identified by its light color, is set on the grass, put there after the failure.

Detail of failed sediment control on Route 1804 south of Bismarck on July 15, 2009.

Note that the mud is thicker downstream of the black plastic silt fence, the opposite of the goal to trap sediment. Also, the tube was broken and the fence fallen.

Remember the painted moose in Bennington, Vermont and the painted fish in Escanaba Michigan? We found their western counterpart in Bismarck, a painted horse, standing in front of a local business.

Folk-art plastic horse in downtown Bismarck, North Dakota, painted with local color.

Though the photo doesn't do it justice, there is a brown skyline of buttes and pointed summits. In the foreground, are buffalo grazing on the range. On the face is a branching pattern of streams characteristic of badland topography. On its rump are roadside flowers that look either like miniature sunflowers or over-sized daisies.

It took us half an hour to find a motel for the night. There's construction going on all over. Bismarck is booming.

After of late dinner, I asked our waiter Tom what he liked about fresh water. "You can land a plane on it." He was reflecting back on his earlier experiences in California, from which he had moved. Thus far on our trip, he was the most health conscious about his water, perhaps because he was the first native Californian we had encountered. He wouldn't drink water from the tap at all, not ever. Instead, his family drank only home treated water, usually from a device with the trade name Multi-Pure, which I find to be an oxymoron because to be pure is to be one thing, stripped of everything else. He mentioned that their family drank Willard Water, which is water treated with some kind of magic catalytic potion. It sounds like snake oil to me.

Day 19 – Good Lands and Bad Lands

We woke to yet another day of steady wind, blue skies, and bright sunshine. This is great news for being outdoors. Its bad news for evaporation. The availability of water is beginning to be a real issue around here.

Bismarck Folk

At breakfast, I was taken aback by Vernie's comment. She was the sixty-something host for the restaurant at breakfast.

When asked her about the highs and lows of freshwater she looked puzzled, then agitated. So, I decided to back up and start with a more fundamental question as bluntly as I could: "Do you know what freshwater is?" "No," was her reply.

In Bismarck, a land far from the sea, water is simply water. Once she understood what I meant by "freshwater," she responded by asking, "What would we do without it?" On the down side, she had "No complaints." This was the most uncomfortable interview from the trip, The only worse encounter I had was a young woman waiting for the restroom in a sandwich shop who thought I had ulterior motives and decided to ignore me.

My next informant was Doug, a 50-something hot-dog chef working beneath a tent outside of Dan's supermarket. They were offering the great American diet of a hot dog and a coke for only a dollar. "Ya know, we don't want no pollution in the water. That's my concern." He was also from California, having moved back to Bismarck to take care of elderly parents. He didn't like the water from California's reservoirs.

He much preferred the local water because it "came out of the mountains," and flowed down the Missouri River. I then responded that most the Missouri River is dammed up and replaced by muddy reservoirs and that I thought Bismarck's water came from a reservoir behind Garrison Dam. "That's a lake," he said referring either to Lake Audubon or Lake Sacagawea. If he likes the water for its associations, then that's just fine with me.

Cattle and Coal

The first photo of the day was of the Missouri River between Bismarck and Mandan, looking north.

Free-flowing Missouri River in North Dakota photographed from the bridge between Bismarck to the west and Mandan to the east.

Lewis and Clark worked their way against the current in 1805. Today, a similar trip would be on slackwater, within reservoirs impounded by great dams. The Missouri is one of the most heavily altered bodies of water in the nation, thanks to the U.S. Army Corps of Engineers. Basically, this isn't North Dakota water at all, but Montana and Wyoming water east of the Cordilleran divide. They just don't want to let it go by without using it first.

It wasn't long before we decided to take a sixty-mile side trip, which turned out to be an 82 mile side trip heading toward Center on Route 25, to visit the place where Kristine's ancestors emigrated after leaving Denmark in the late 19th century.

Cut bank of Square Butte Creek near Harmon, North Dakota. Square Butte Creek enters the Missouri just a few miles north of Mandan.

Terrace in the valley of Square Butte Creek near Harmon, North Dakota.

Cattle near Sanger, North Dakota, which lies above the Missouri River about 20 miles north of Mandan. They ran away when I approached.

Typical scene near Sanger, North Dakota.

Consider these to be artificial potholes. Here, the main problems are the concentration of alkali salts.

Before the 1960s, this was ranching country, with little else to support the economy. Now, there are jobs provided by the Minekota utilities corporation, which burns strip-mined coal for electric power.

Lone Wolf Saloon in Center, North Dakota,

It had three customers by early afternoon on Friday, July 16. I show this photo of the saloon where the coal miners hang out in lieu of a photo of the distant plants, which were too far to photograph well.

The plumes of the emissions stack run continuously, day and night. We also saw plumes west of Sanger, North Dakota, where something similar is taking place about ten miles to the northeast. Coal mining is another indicator that we had left the Upper Midwest for the true west. The Upper Midwest is underlain by the wrong kinds of rocks, and the glacial cover is much thicker.

From the coal-fired power plants, power lines head off toward Bismarck-Mandan. That city is literally lit up by strip-mining. It's bright city lights also come with the consequence of carbon pollution. Concern about greenhouse emissions doesn't seem to be a problem around here, probably because jobs are at stake. Another important point, is that these folks are used to taking whatever is thrown at them by the weather, blizzards, thunderstorms, hail, floods, droughts, locusts, deep freezes. It's the city folk who seem to care most.

A side note on the issue of global warming. At 3:01 PM on July 16, 2009, we watched a local resident get out of his massive white Chevy pickup truck and walk into the gas station. In addition to the requisite blue jeans, he was wearing a puffy down coat over a thick insulated gray sweatshirt. I doubt that he is that concerned about global warming.

Curiously, there was a wind farm of several dozen turbines located between the two coal mining operations, probably within sight of both.

Immigration

Our side trip to Center was not taken to do genealogy, but simply to visit the place where Kristine's grandparents met in Oliver County. The county seat in Center, North Dakota, is not too far off the center of North Dakota. Center's water tower was perched on the highest hill, a butte left over from countless rainstorms of the past, each of which removed a little of the landscape.

Water tower for Center, North Dakota.

This tank is one of the most photogenic we've seen. It will make a nice addition to our water tower album.

It's a good thing the water is enclosed in a tank. Just below the tank was a puddle in the process of drying up in the steady wind.

Dried up puddle below the water tower in Center, North Dakota.

Its surface was fractured with mud-cracks in the brown, silty, pebble-free mud. They tend to curl upward because shrinking is greatest at the top, where the finest mud and clay settled.

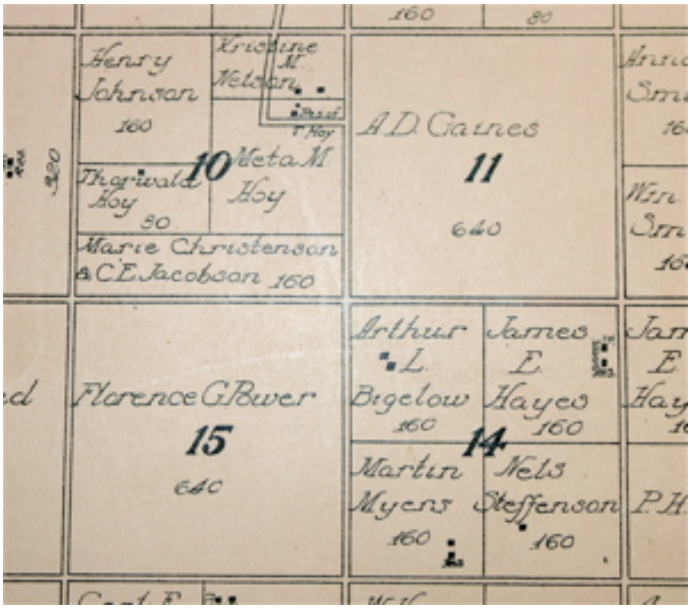
After the water tower, we wandered around town. Kristine's grandmother was a schoolteacher who left Indiana for the edge of the frontier. At the time, many schools were simple, one-room affairs like this one, which had been moved to the center of town by the Historical Society.

One-roomed prairie schoolhouse in Center, North Dakota.

In the county building, we met Mickie McNulty-Eide, Deputy Commissioner for Deeds, who helped us locate the ancestral homestead on Kristine's side of the family.

Millie McNulty-Eide, the Deputy Commissioner of Deeds for Oliver County.

Homesteads were 160 acres in size, which is the area of a quarter section of land. A section, which contains 640 acres, is a mile square. Each township has 36 sections. Doing the math, there would have been 144 homesteads per township,



Map from the land records for Oliver County, North Dakota featuring Section 10 of Township 142 East, Range 82 West.

This is the section of land homesteaded by Kristine's great grandparents who emigrated

from Denmark. Her great grandfather was named Christian Hoy Jensen. Her great grandmother's name had several versions among them Mette and Meta M. The family dropped the Jensen part of the surname, leaving Hoy as the last name for the descendants. The black squares show the buildings of the homestead, where Henry Victor Hoy, Kristine's grandfather, grew up and then, as a young man, ranched.

Using my Delorme Atlas and the odometer of the car, we drove dirt and gravel farm roads until we reached the quarter section of land homesteaded by her relatives.

Valley of Sherk Creek, with the land of Henry Victor Hoy in the background.

Their homestead lay in the base of a lovely valley cut by Sherk Creek, provided a southerly aspect for warmth, good water, a protected site for crops, good rangeland on the higher slopes, and easy road access. Prairie wildflowers were in full bloom, Black-eyed Susans, purple vetch, and wild rose.

Panel of prairie wildflowers above Sherk Creek, North Dakota on July 16, 2009.

They did not farm. They ranched. I find no sense of the Upper Midwest here. It's pure

west. In fact the North Dakota Cowboy Hall of Fame is only a few hours to the west.

Road to Medora

Having spent half the day in search of our family past, we took a beeline to Medora, where we had booked a room for the night. Our first stop was Sweet Briar Lake, just northeast of New Salem.

Sweet Briar Lake, near New Salem, North Dakota.

It was a typical reservoir. In map view, it was carrot-shaped, adorned with triangular points of drowned tributaries. I looked for the dam, but couldn't find it. I suspect the road had been built right over it's top. Also typical were steep banks eroded by waves.

Richardton, North Dakota, founded in 1883, was our next stop.

Entry sign for Richardton, North Dakota.

To the right was a historical marker, with the following text: "The Yellowstone

Expedition of 1876 organized to quell the hostile Sioux, marked from Fort Abraham Lincoln May 17, 1876 and camped near Young Mans Butte about two miles east of this marker on May 23, 1876. Between Young Mans Butte and Richardton, the Custer Trail intersects the highway, continues in a general westerly direction, and enters Montana near Beach North Dakota. The trail extends to the banks of the Little Big Horn River in Montana where Custer and a Portion of the 7th Cavalry were annihilated by Hostile Indians on June 25, 1876."

In nearby Taylor, we drove by the "Sit 'n Bull Bar. Clearly, were still on the Custer Trail. The next event of significance was the first of several pumping oil wells.

Oil well and tanks 2-3 miles east of Belfield, North Dakota.

The water story here is about contamination. When fossil fuels are trapped beneath the earth, the sequence from top down is gas, oil, and briny water. This briny water, when it comes up with the oil under pressure, is one of the hardest management tasks of the oil business.

Our final stop was the Theodore Roosevelt National Park, probably one of the least visited in the nation. The story behind the park is fascinating. At one time, there were more than 40,000,000 buffalo grazing the high plains. By the time Teddy Roosevelt arrived in 1883, there were just a few thousand left. This was during the Gilded age, when shooting large game animals is just what men did for sport. So, Teddy took a train from New York to bag a buffalo before they were completely gone.

Though the hunting conditions were poor, he was successful in getting his trophy and sending the head back east on the train. But in the process, he had fallen in love with the west. It was here that this extraordinary man was converted to become the nation's most

conservation minded president.

Entry sign at the Painted Canyon Visitors Center, Medora, North Dakota.

Badlands of Painted Canyon, Theodore Roosevelt National Park, Medora, North Dakota.

There we met Patti Schaefer, who works for a foundation dedicated to sharing the park with tourists. What she liked about freshwater was that it clarifies when you let it settle. Brown water becomes clear when you let the mud settle out. She also likes fishing, especially for catfish, denizens of murky water. On the down side she was concerned about the recent fish kills in Patterson Lake, a reservoir above Dickenson. Even worse, she said, was the Red River, which residents outside of North Dakota usually refer to as the Red River of the North. It drains the northeastern part of the state toward Hudson Bay. Her concern was the pollution: “You can’t drink it, swim in it or even look at it. It’s disgusting.”

Things are greener around here, which is nice, but they are green because of the recent

terrible winter, which is not so nice. Frequent storms made many roads, including Interstate 94, impassable.

The other attendant had a most unusual name, “Quadraline.” She said that my question about freshwater was one of the “weirdest” she had ever heard and “really ambiguous.” I explained that it was less ambiguous than it was open ended, designed to capture whatever was on someone’s mind, in order to compare results across the country. She likes water you can taste; otherwise “why drink it at all.” She hates the bottled stuff that isn’t flavored and “tastes like nothing.” Even worse is water that’s treated too much. Water from deep wells around here, she said, is very soft and it “makes awesome coffee and awesome tea. There’s no crud in it, you know,” referring to the “scum that forms on tea,” when you use hard water.

This was a Friday night during peak tourist season. We were lucky to get a room.

Day 20 – The Final Distance

Medora was a lovely place to lake up. Bright sun, Crisp Air. Hardly a trace of humidity.

Cowboy Town

Bluffs behind Medora, North Dakota, were cut by the Little Missouri River.

At one time, the high plains were continuous from the Rocky Mountain Front near Denver to the Mississippi River. They were composed of the clay, silt, and sand of deltas and alluvial plains of large rivers that carried sediment produced by weathering in a wet, semi-tropical climate. High topographic relief and bedrock exposures are due entirely to localized down-cutting through these strata by fairly modern rivers.

At the Visitor Center, we took tour of the Maltese Cross Ranch house given by Mary Ellen Ergle.

Maltese Cross Ranch House, Theodore Roosevelt National Park, Medora, North Dakota.

If I understood correctly, this cabin-sized ranch house was built for Teddy Roosevelt long before he became president. He and the cowboys he employed on his ranch lived in it together. Originally located on the site of the Maltese Ranch, it has been moved for exhibit many times, finally ending up at the visitor's center.

Desiccated timber at the Maltese Cross Ranch Cabin, Theodore Roosevelt National Park, Medora, North Dakota.

Two related themes from the day are shown in the photo above. First is the crispness of

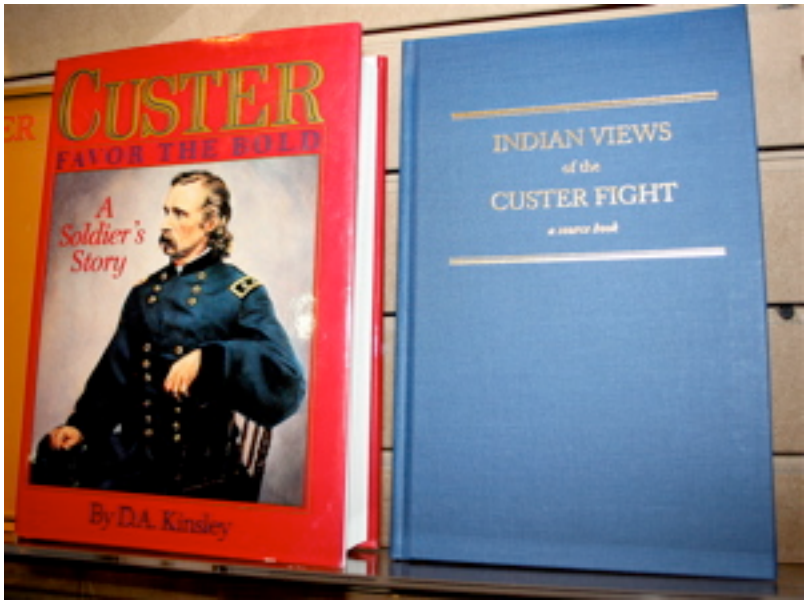
the shadows created by intense sunlight. Such sunlight can only occur when the air is extremely clear, as it is here because there is little moisture in the air. With such little moisture, wood above the soil surface preserves very well. And when accompanied by a steady breeze, the rate of evaporation is very high, causing desiccation. Water, rather than nutrient, sets the limit on life in this place.

Later, she reflected on how beautiful the water was in all of its splendid turbidity, with pastel earth tones ranging from slightly off white to reddish brown. Her main concern was that energy development was raising pressures to build another bridge across the Little Missouri River, which she believes would compromise the beauty of the land she has learned to love. They would truck it on what is now a silent place.

Another staff person, Lilian Crook described a kayak trip that offered unexpected pleasure of floating by a family of baby beavers swimming with one of their parents. Here concern was with low-water crossings, which were being filled to cross with vehicles, changing the courses of the stream.

Material on exhibit at the Medora Historical Museum, Medora, North Dakota.

During western settlement, the materials of everyday life came almost entirely from factories in the eastern and Midwestern United States. In an earlier era, material for New England and Virginia colonies came almost entirely from factories in the Old World.



The Custer section at the Western Edge Bookstore in Medora, North Dakota. There are dozens.

Never have I seen an entire wall of books about General George Armstrong Custer. American in general and this town in particular have a love-hate relationship with General Longhair, whose final moments captured many emotionally-rousing themes associated with the human condition: tragedy, revenge, war, heroism, misjudgment, race, arrogance, Manifest Destiny, Native Americans, cultural extinction. In my quick scan of the section, shelf, I found only one book dedicated to the Indian point of view.

Adjacent books on the shelf of Western Edge Bookstore in Medora, North Dakota.

The plain cover on the book about Indian views suggests that it's the content of history that matters, not the marketing.

Cotton was flying everywhere in Medora. It carries the seeds of the cottonwood tree on the wind; hopefully to a spot wet enough for germination.

Cottonwood tree, downtown Medora, North Dakota.

With such a steady breeze from one direction only, I wondered how such a tree could ever spread upwind to the west. For the rest of the day we saw cottonwoods lining the bottom of every watercourse, from small creeks to the banks of the Yellowstone River.

The strata around Medora are rich in bentonite, a clay produced as a byproduct of the weathering of volcanic ash. One of the most fascinating things about bentonite is that it actually takes water into the mineral structure, expanding in the process, and producing a water-tight seal. It's impervious to infiltration that is used to line the bottom of ponds and the casings of wells. So, when it rains around here, the water cannot infiltrate. Rather the rain runs off, usually in torrents, which is why a city like Medora needs to pay special attention to its surface drainage.

Cement drain in downtown Medora, North Dakota.

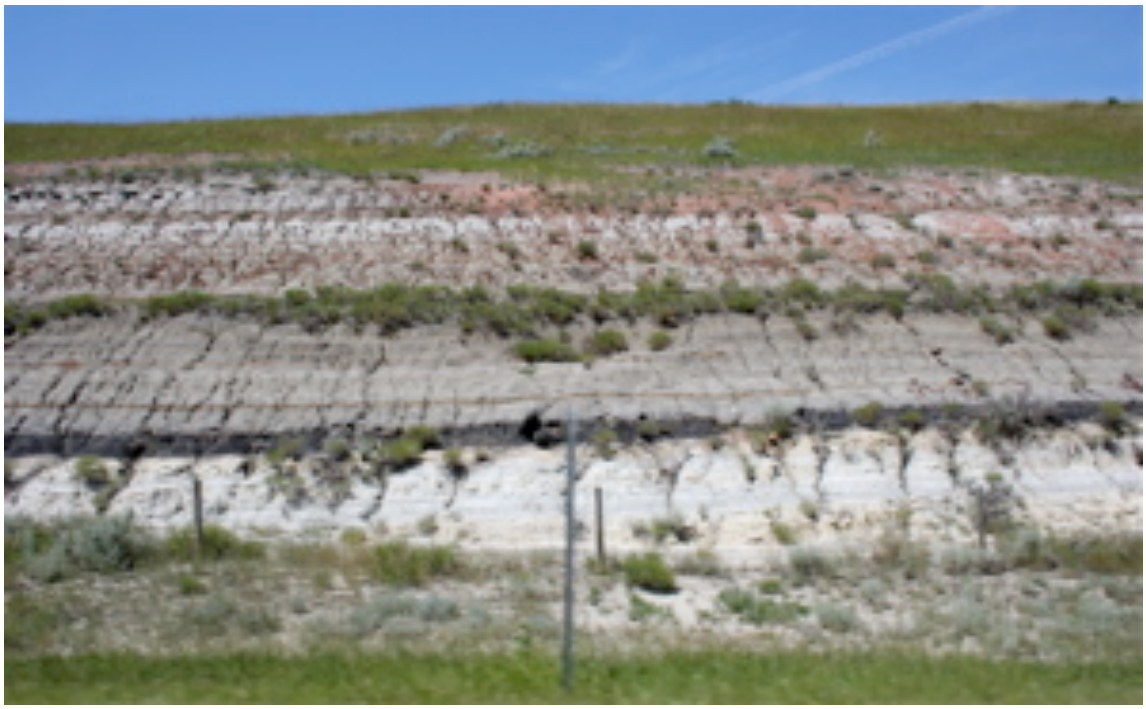
Red Clinker

Medora was so fascinating, that we left much later than we had planned to. Despite our urgency, we didn't get more than 100 yards before finding one of the most interesting water stories of the trip.

Little Missouri River, looking northeast from the bridge at Medora, North Dakota.

Taking this photo made me realize how interconnected the water system is on earth, in time as well as in space. Here, the river is muddy because it has incorporated and suspended river mud from an era when mammals were just beginning to dominate North America (Paleocene). Also in the river are gravel bars composed of an unusually red, quite jagged gravel.

That's clinker, otherwise known as porcelanite. Essentially, it is natural "redware," the name given to primitive pottery of colonial America during the 16th and 17th century. To manufacture the pottery, muddy clay was shaped on a potter's wheel, then fired and glazed. Here, on the high plains drained by the Little Missouri, the muddy clay was fired by nature, by seams of lignite coal that formed when the area was a large, freshwater swamp. After deep burial and exposure, the coal seams were set on fire by lightning strikes, and then burned for centuries to millennia.



Strata exposed in a highway road cut east of Beach, North Dakota, shows a bed of red clinker (burned coal) above black coal strata that are not burned.

The heat from the burning coal "fired" the adjacent muddy clay to its red color and made it brittle, hence both hard and easily fractured.

Close-up of crushed clinker used for road-bed materials above bentonite soils on Montana Route 216 about five miles south of Sydney.

This natural red ware is the only source of gravel around here and is responsible for the unusual beauty of the river bottoms. For human use, the clinker is crushed for gravel roads and substrate for pavements.

Red dust from gravel roads on back of Subaru Outback in Medora, North Dakota.

Hence the connection between the black coal in the outcrops and the red dust on the back of the Subaru Outback we saw parked on the street.

Borderlands

Interstate 94 west of Medora had light traffic. Only one car passed us when we stopped to photograph this water tower during mid-afternoon on a beautiful day.

Water tower in Beach, North Dakota, just east of the Montana line.

Beach? The nearest ocean beach is easily more than 1500 miles away. Some day, I'll have the time to find out why this town was named.

Just over the border was the Montana Welcome Center at Wibaux. There we met Darlene Brown, who works for the local chamber of Commerce. She was completely surprised when I told her I was heading up toward Plentywood, far off the beaten track of tourists. Her main concern was that the water is so polluted with nitrates that it could "kill a baby." This was from agricultural runoff and infiltration. Their family gets water from

the well on their ranch. They don't spray, except just once when the grasshoppers got too bad.

Beyond that was the town of Wibaux, itself, named for a cattle entrepreneur from France, On the way into town, I got my first exposure to culvert art, created by a local resident named Joe Burnam.

Bucking bronco art made from old culverts, Wibaux, Montana.

The library was our most interesting spot. It shelved books in an old, and very large bank vault, where cattle money used to be deposited.

Books housed in bank vault in Wibaux, Montana.

Main Street of Wibaux, Montana, just west of the Montana line.

Their Montana Room, which held books on the state, was formerly a walk-in small room-sized bank safe. The building had been built as a bank to keep all the money ranching produced. Later, it was the jail. Now, it houses precious books.

A senior in high school, Jackie Quinn relayed a story about almost drowning in the Yellowstone River near Billings to save her dog, which couldn't swim. That was her response to a concern about freshwater, you can die in it. What she likes most about fresh water was that you can get it quite cheap at the Coke plant.

I inquired further because I wanted to make sure I got the story right. Indeed, there is a

Coca Cola bottling plant nearby. To meet manufacturing specifications, they have to filter and purify the water of its deep-down chemistry that is very soft, rich in sulfur and sodium.

They go there with five gallon jugs, which they fill for approximately a dollar a piece. I wondered how different this Coke water was to the city water sold by the Water Depot in Woodstock for nearly four times the price.

A Lonely Stretch

From Wibaux, we drove north on Route 216, a distance of 54 miles, encountering no traffic either direction for the first fifty miles.

Route 216 midway between Wibaux and Sydney, Montana.

The central 12 miles were made of gravel, in this case of crushed clinker, a.k.a. porcelanite. I suspect that this material need not be mined at all, but could simply be dug directly from gravel bars in small rivers.

To the east and west, the road moved mostly through subdued badlands, with outcroppings being both rare and distant. Fences ran continuously along the way, with distant cattle visible on the hills. We encountered no human being working outside, despite the fact that we went by several clusters of ranch buildings in the last third of the way. En route, I wondered when the last person came through here in a Volvo with Connecticut plates.

The availability of water seemed to be the limit to ranching in this vicinity. One

excavated stock pond we drove by in the distance was completely dry. From its white color and cracked appearance, we guessed it to be combination of bentonite clay and salt.

Dried up stock pond on the highlands on the road between Wibaux and Sydney, Montana.

More commonly, the beds of local streams would be excavated, with the dredging spoils being used to build a dam on the downstream side.

Excavated and dammed stream for livestock watering on Route 216 approximately a dozen miles south of Sydney, Montana.

The encrustations along the pond edge are a sure sign of excessive evaporation. Approaching Sydney, we began to notice that oil wells were quite common.

Oil well borders the road between Wibaux and Sydney, Montana. Its gravel pad was composed of crushed clinker.

We saw dozens such wells within the next hundred miles.

Between the Rivers

Just south of Sydney, we crossed the floodplain of the Yellowstone River, which was covered with spray irrigation devices.

Yellowstone River at the bridge to Sydney, looking upstream to the south.

The river was turbid, but with a grayer color more suggestive of glacially ground up mid

than with the rusted clays of badlands country. The edge of the river contained black chert and volcanic rock with free-floating crystals, exotic stones we had not seen since leaving the Canadian shield of northern Michigan. These were from ancient rocks in the distant Rocky Mountains, seemingly a world away.

The river also contained what most Midwesterners would call exotic fish, especially sauger.

Sign beneath bridge crossing of the Yellowstone River at Culberton, Montana, asking recreational fishermen to help with fish research.

At this point, the river flows in a fairly straight channel, beginning to meander near the North Dakota border before joining the Missouri at Buford, named for the historic Fort Buford. Between Buford and Williston the river flows about 40 miles to reach the western tip of Lake Sakakawea, which is impounded by the Garrison Dam more than a hundred miles to the east.

From the map, the Yellowstone flows more strongly than the Missouri. This prompts me to think not only of the Missouri River, but also of the headwaters question regarding the great Mississippi System. Why is the link between Buford, North Dakota, and Saint Louis, Missouri, not named the Yellowstone River? Why is the head of the Mississippi River considered to be more important than the head of the Missouri system, which is really the head of the Yellowstone system?

Sydney runs on cattle and oil. Driving through downtown, we couldn't help but notice two culturally significant signs. The first was the "Lucky Buckle," which looked like a clothing store from the street, probably selling western wear. A block down was the largest local watering hole (western-speak for drinking establishment): the "Cattle-ac Saloon." It doesn't get any better than that, a place that embodies America's love of the automobile and its beef cattle in one word.

Cattle-ac Saloon in Sydney, Montana.

The same sun that makes such bright colors and stark shadows creates in human beings a powerful thirst and a desire for shade.

Our destination for this leg of the trip was Culbertson, Montana, which lies on the north side of the Missouri River. Was it an accident that both Sydney and Culbertson lay on the north side of the river?

Approximately four miles south of town, and on the east side of the road we spied an enormous boulder of hard rock, a banded gneiss with a vein of granite running right through it. Without question, this boulder had come from the Canadian shield, far to the northeast, perhaps from as far away as Keewatin, on the west side of Hudson Bay. We had crossed the glacial limit. I had suspected this earlier, having seen rounded, light-colored spots in the distance that I interpreted as ancient sun-bleached boulders, but which could have been the mounds of dirt above badger or prairie dog holes. The gneiss boulder weighed nearly a ton and was diagnostic of long-distance transport by ice.

Our purpose in leaving the glacial limit and re-entering it here was to see if the water issues of the glaciated landscape were different, which they were. South of the limit, the land was nearly overwhelmingly given over to ranching, principally for beef cattle, dominantly Angus and Hereford breeds. I don't recall seeing a single dairy cow or any corn, except in a few protected hollows, or for that matter, many cultivated fields at all.

Gradually, the number of boulders picked up, to the point where we began seeing piles in cultivated fields. The brown layer above the rock outcrop thickened to the point where it could be confirmed as till, rather than the subsoil. Deposition of this substance, rather than erosion of soft strata became responsible for the undulating character of the terrain,

something we hadn't seen since near Mandan back to the east. Subdued buttes and sections of badlands were still present, but only on the high points, remnants too large to be sheared and smeared by the passing ice.

As we neared the Missouri River, we could see the gallery forest of cottonwoods along the meandering stream. The fields were rich on the alluvial plain, being watered with spray irrigation. In the distance, we could see a return to the Tertiary strata the glacier had covered to the slough. This return was due to erosion by the Missouri River, which carried torrents of glacial meltwater as an ice marginal stream.

Missouri River looking downstream to the east at Culbertson, Montana.

Beneath the Culbertson Bridge was an old, beaten-up U.S. Geological Survey Gauging Station.

Staff gauge for measuring water height at the Missouri River Bridge at Culbertson, Montana.

A staff, mounted on mangled sheet piling, was marked off in feet and tenths of feet to determine the height of the river, its stage. I found it curious that it was rust at the top and bottom, but not in the middle, where the pilings were white. This, I suspected, was the range in height at which swift-flowing currents carrying silt, scoured off any rust that forms on a nearly seasonal basis. Most of the time, the river runs fairly low.

Modern U.S. Geological Survey Stream Gauge at the Culbertson Bridge, Montana.

With the old gauge, a public servant drives out to the bridge, heads down to the river, and visually reads the gauge, sometimes with binoculars. With the new gauge, there is no need for an employee. Sunlight powers photovoltaic cells, which generate electricity to power an automated electronic transducer that reads the stage of the river by measuring the hydrostatic pressure in a column of water. That information is then automatically logged onto a digital file at the station and sent via radio waves to some distant computer for archiving and analysis. The clean, high-tech gauge is a lonely gauge, as independent as a Mars Rover.

When I graduated from college in 1973, one of my buddies got a job with the U.S. Geological Survey driving around and collecting data from stream gauges. Young people who used to work their way up the career ladder no longer have that opportunity. The analysts sit inside in front of a computer, as I am doing now, rather than being outside.

When westerners think of rivers, their thoughts are usually drawn either to the extremes of flow, whether destructive floods or times when the river dries up. Between those limits, we tend to take flowing water for granted. Those USGS analysts may not even see the rivers much anymore.

To the Limit

Two miles north of Culbertson, Montana was a dramatic change in the terrain. All of a sudden, we were on an undulating plain rich with cultivated fields and dotted with boulder piles here and there. Verdant green wheat was the principal crop, with yellow-flowering canola fields common as well.

When we reached Homestead, it seemed to us that we were back in the upper Midwest--rather than the west. The cultural icon of the rain elevator, water tower, small towns smothered in trees, and endless fields surrounding them. Soil, rather than climate or culture, set the boundary between rangeland and farmland.

Medicine Lake was rimmed by extensive marshlands and many birds. Medicine Lake is one of the more important wildlife refuges run by the U.S. Fish and Wildlife Service.

Medicine Lake, Montana. The presence of water makes it easy to see how flat the landscape really is.

My original plan was to head north to Plentywood, Montana for the night. Later, we decided we might not find a motel or library there with the functional Internet service we needed to make our final blog post. Instead, we decided to overnight in Williston, North Dakota, the only place within 130 miles with more than one motel, so we were told. To reach Williston before dark, we had to turn east at Reserve, Montana before heading back into North Dakota.

Reserve exhibited a skyline dominated by grain towers little different from Edgeley, North Dakota, which we had seen four days earlier.

The limit of our trip at the junction of Route 16 North and Route 258 East, in Reserve, Montana. The town is barely visible left of the sign.

If Reserve has a water story, it's the absence of a water tower visible from a distance. It lies on the banks of Big Muddy Creek. Perhaps after the sediment settles out, they have a reliable supply.

Were it not for the rich farmlands all around us, one might call this country bleak. We drove west by the Eden Valley cemetery, which was very well kept, despite being miles from the nearest valley and without so much as a tree. If ever there was a nearby church, its now gone, perhaps burned to the ground. Another sign that could be misinterpreted as signifying bleakness was a completely intact, but thoroughly abandoned set of farm buildings Brush Lake Road north of Dagmar.

Abandoned cluster of farm buildings (including the base of a windmill) northeast of Dagmar, Montana. The buildings are completely surrounded by wheat.

The windmill is an icon of the upland prairie, a place where groundwater is often the only

source of water. One of my earliest memories was climbing such a windmill tower to its top, despite explicit instructions to stay away and despite the threat of certain punishment. I must have been less than five years old. I remember the combination of excitement and fear, and of feeling my heart throb in my chest in the process. Of course, my mother would have had heart failure had she known what I was up to. Perhaps she will find out in reading the account of this road trip.

Dagmar, set a half-mile in from the county road in the middle of a section, was an anomaly. People still live there on its two or three streets, and tend the cluster of trees that protect them from the wind. Driving by at a distance of a half mile, we saw no water tower, no grain elevator, and no steeple. This puzzled us. Here was a huddled community if I ever saw one. Mechanized machinery has expanded the distance between farms. Homesteads, which began at 160 acres, were not abandoned, but incorporated into ever-enlarging farms.

Our final stop on the entire trip was to visit Brush Lake; the most easily reached small kettle lake within a cluster that stretches northwest to Dooley near the Canadian border, and eastward into nearby North Dakota.

Brush Lake in Sheridan County, Montana. State park is the cleared patch of beach visible on the opposite shoreline.

To the south lay additional kettles within a kettle moraine, these occupied by various waterfowl and rimmed by marshes.

Here was a beautiful lake, precious in its rarity, and crystal blue in its quality. But people were completely absent. At its south end was a decrepit park, blocked by a locked gate. The few wood-frame buildings present seemed abandoned. Some were falling down, others being enveloped by brushy trees. There were no parked automobiles. We didn't see or hear a soul.

After a steep climb to the east side of the lake, our first steep slope in more than twenty miles, we turned north on gravel toward Highway 258. Along the way, we passed by the road to Brush Lake State Park, which was clearly marked with a sign similar to the one we had seen seven miles back before we left the main road for Dagmar, and eighteen miles back when we left the main road at Reserve.

I regret not driving the mile of gravel road to the shore to see if there was someone to interview. Earlier, we had decided that the park must have been closed, because we saw no cars and no activity there when we stopped across the lake, seeing nothing but a small swimming beach with no cars and no people visible

It was there, surrounded by fields of silently growing wheat and at that lonely junction between two gravel roads, that our road trip ended.

The End