
DAVID W. SCHINDLER

David William Schindler, OC, D Phil, FRSC, FRS was born in [Fargo, North Dakota](#) ~~Barnesville, Minnesota~~ on August 3rd, 1940. [He grew up in nearby Barnesville, Minnesota.](#) At ~~the University of~~ North Dakota [State University in Fargo,](#) he initially studied engineering and physics, but a summer job as a research assistant to a biologist resulted in his shifting his major to Zoology. He completed a B Sc degree in 1962 and received a Rhodes Scholarship enabling him to complete a Doctorate in Aquatic Ecology at Oxford University. In 1966, he accepted a teaching position at Trent University and, in 1968, was recruited by the [Fisheries Research Board of Canada, later to be replaced by the](#) Canadian Department of Fisheries and Oceans. Schindler was instrumental in the formation of the Experimental Lakes Area (ELA) freshwater research program [in northwestern Ontario](#) and moved to Winnipeg where it was headquartered. He [first](#) undertook research that challenged theories held in the 1960s that carbon was responsible for the over-fertilization problems of lakes. His team proved that phosphorus was the key stimulator of plant growth and animal population changes in lakes, and that the lakes could be brought back to health through the control of phosphorus. This resulted in changes in legislation not only in Canada but also abroad. He then focused on the harmful effects of acid rain leading to policy changes, including restrictions on acid emissions. In 1989, Schindler moved to the University of Alberta to become the Killam Memorial Chair and a Professor of Ecology. There he has worked on the effects of climate change, particularly on Canada's Alpine and Northern Boreal Ecosystems, UV radiation and the impact of increased acidity on Boreal Lake Ecosystems, [and on the effects of the oil sands industry on the Athabasca River.](#) He teaches limnology; the philosophy, sociology and politics of science and science and public policy in Canada; and environmental decision making. He has been honoured in Canada and internationally.

Date and place of birth (if available): 1940, Fargo North Dakota

Date and place of interview: Office of Dr. David Schindler in the Biological Sciences Building at the University of Alberta, March 7, 2013

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Name of interviewer: Adriana A. Davies, CM, PhD

Name of videographer: Jimmy Bustos

Full names (spelled out) of all others present: N/A

Consent form signed: Yes

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Initials of Interviewer: AD

Last name of subject: SCHINDLER

AD: It is the 7th of March and it's 8:59 am. I am Adriana Davies and I'm the Researcher/Interviewer on the Oil Sands Oral History Project. I am in the office of Dr. David Schindler. David, thank you so much for agreeing to be interviewed for the project.

SCHINDLER: You're welcome.

AD: As you know, the videotaped interview and the transcript will reside in the Glenbow Archives and will be available to researchers and, we hope, will be one of those little legacy pieces that will be of value in determining a number of outcomes in terms of the oil sands in Alberta. Now, I'll begin by asking you to state your place and date of birth, and then to give me a summary biography, in broad strokes, and then we will drill down and talk about your specific scientific background and your involvement in the oil sands.

SCHINDLER: My family comes from Northwestern Minnesota; I was actually born in Fargo, North Dakota which was the nearest hospital in 1940 when I was born. I spend most of my early life in Northwestern Minnesota. I went to school in a little town known as Barnesville, and I did very well at school. I was told by my advisers that I should become either a medical doctor or an engineer. I knew medical doctors spent a lot of time indoors, which I didn't like, so I decided to become an engineer.

I got a scholarship to the University of Minnesota; spent two years there hating engineering. I was good at math and found that the math part was very easy. The physics problems were more interesting and I always did very well at physics but something was missing. And, then, by accident in the summer after my second year, I met a biologist, [Gabriel Comita](#), at North Dakota State University, or as it was then North Dakota Agricultural College, who was looking for someone to set up and run a bomb calorimeter to do energy contents of organisms so that he could follow



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energy transfer in food chains. I didn't know anything about food chains except from what I had learned from fishing but I knew bomb calorimetry because it had been freshman physics and I got a job with him for the summer. That summer I read my first ecology texts and reference works and I switched fields, switched universities and never looked back.

I knew exactly what I wanted to do. My favourite book then was one written by Charles Elton, widely regarded as the father of animal ecology, which was called *The Ecology of Invasions by Animals and Plants*. It was written in 1958 and it was the first documentation of how human travel around the world and human trade were moving organisms to ecosystems where they didn't belong, and how some of them were creating havoc with the new continents. He actually speculates that this would be very important and that it needed to be considered in the ecology in the future world.

That book just blew me away. I wanted to work with Elton, ~~and the fellow that employed me,~~ Gabe Kameeda Comita one day came up with a little form and threw it in my lap when I was sitting in his office and said, "You should apply for that; if you got that, you could ~~go~~ apply to work with Elton." It was a Rhodes Scholarship application. I didn't think I had the credentials to get a Rhodes Scholarship, but I had one publication, ~~was~~ in *Science*, ~~and~~ I think a good example of how naive I was, I thought *Science* was a low-class journal and, if I got really good, I'd get to publish in specialists journals. That, and a little bit of athletic ability, and good grades generally were enough.

I had never been east of the Wisconsin/Minnesota border before, ~~but~~ was parachuted into the UK - talk about a culture shock - ~~but~~ I ended up getting a DPhil [Doctor of Philosophy degree] there. I visited Minnesota a few times while I was there, and I didn't like what was happening. Forests were being cut and lakes that I had enjoyed fishing were being ringed with cottages and all sorts of heavy development ~~was~~ going on.

The jobs that were open at the time were in gritty industrial cities like New Haven, Connecticut, and Ann Arbor, Michigan, which I thought was just a suburb of Detroit, ~~or at least so it seemed to me.~~ So, I was very grateful when I was able to get a job at Trent University, which was brand new, in Peterborough Ontario. I sort of escaped the US as an ecological refugee. I didn't really like being a university professor. In those days Trent was suffering from some growing pains and Ontario was in its first budget crisis. The new smaller universities were taking a big hit. At the time, this new opportunity to head the experimental lakes area cropped up, which looked to me like a great outdoor adventure, among other things, and the group that was assembled in Winnipeg, ~~which was~~ a place I really didn't want to live, was like a "who's who" of aquatic sciences, ~~S including~~ some of the very best scientists in Europe and a collection of the best young talent in North America, so it was a group that was both awing to work with, for a young scientist, and a lot of fun because of all the people similar in age.

So I took that job, founded and landed in Experimental Lakes Area for 22 years, ~~and,~~ ~~At~~ that point, feeling the need for a change after 22 years, and having a wife who had been unemployed for 10 years working on "soft money" because the small university ~~in Winnipeg of Manitoba~~ had no position for her, we started looking for places where we could both have careers and turned out the



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best opportunity was here at the University of Alberta. In 1989, we packed up our belongings in Winnipeg and moved to Alberta and have been here ever since.

AD: Thank you for the overview of the evolution of your educational and work life and career. Now, I want to go back to your work with fresh water lakes for the federal government. Which ministry would that have been under, which department?

SCHINDLER: Alright. Well when I joined the Fisheries Research Board, it wasn't a ministry. It was a unique organization known as the Fisheries Research Board of Canada and it differed from a federal department in that it didn't report to a minister or to any other politician. It reported to a board of senior scientists in; fisheries, oceanography and limnology. The board decided who got funded and so forth. They were handed money by the federal government to spend on things that were in the best interest of the Fisheries and Aquatic Ecosystems in Canada. It was a great organization, almost no administration, almost no control; a very egalitarian organization where, as a young scientist, I could argue with the Board Chairman if I didn't share his views and so on. It really was a great place to work.

But, in the 1970's, there was jealousy from the Department of Fisheries about this organization. One of the politicians of the day called the board an aberration; it had to be eliminated. So, we were rolled first into the Department of the Environment, along with the Department of Fisheries to become Fisheries and Marine Service and, then, when that was too huge to handle, we were split off as the Department of Fisheries. Frankly, that was the beginning of the down fall. Suddenly, instead of four or five administrators, we had 50% administrators. Suddenly, there were people worried about the minister's image, not the quality of the science we did. As good scientists, as and managers passed on, they were replaced with MBA's and accountants, which remains the fact today. We developed a 14-layer bureaucracy before even getting down to senior scientists, and that persists today. We have senior assistant deputy ministers and things like that in this chain, and one has to usually get down below the lab director to find anybody with any scientific credentials. It's literally like our fisheries and environment is being run by a clowns; that's noan exaggeration.

AD: When you began, Canada was a leader in terms of interest in the environment.

SCHINDLER: Yes, that was one of the things that attracted me here, and all of the colleagues that came from Europe and the US and Japan and other countries. There were no restrictions on where one had to recruit. The board recruited the best people, period. In those days, there was a sprinkling of good Canadians and a lot of them were hired, but a lot of the best talent worldwide was from other countries. Jack Vallentyne, who was my boss and the head of the eutrophication section, was probably the best scientific recruiter who ever existed, and he got people like Richard Vollenweider to win [who won the Tyler Prize for Environmental Achievement in 1986] for his work on eutrophication. Kaz Paetalus, who was athe senior scientist in Poland, and people like that as well as a really good collection of young talent. That's the way science should be done. When we were at our best, we were probably the best educational institution around too, and it all happened in four or five years; everything clicked.



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AD: And, of course, Canada did have some international scientific figures like Pierre Dansereau who coined the term “ecosystem” and began his work in Quebec and J. Tuzo Wilson in plate tectonics, so that there were Canadians that were doing leading-edge stuff.

SCHINDLER: The fisheries analog of that day was probably Bill ~~Ricke~~hter, who was a member of the Fisheries Board, whose fisheries statistical approaches are still used today. There were people of that ilk. Ronald Hayes from Dalhousie University was another person I remember well on the board, and he was a very eminent limnologist of that period. So, it wasn't a lack of good people; probably the most famous of all was Don ~~Rawson~~osenberry, who at the University of Saskatchewan had a group of students who surveyed all of the Canadian Great Lakes and did the most thorough work on lakes - like Great Slave and Lake Athabasca - that's ever been done to this very day. It's kind of an embarrassment to find that all that we know about those lakes was done by a few students from a freighter canoe in the late 1950s, pulling hand lines from a depth from up to 700 metres to get their samples. But, among those students, were a generation of very famous people; ~~Bill R~~Fullerckerehter, who is well known for his work on Bison in Northern Alberta and the Northwest Territories; Peter Larkin, who preceded me as a Rhodes Scholar and was a very famous ecologist at the University of British Columbia, who did a lot of wonderful fisheries work were among them, for example. But ~~it~~the Fisheries Research Board was still small, and to get to the sort of level that we ended up at, Vallentyne had to do an amazing recruiting job.

I don't know of a scientific recruitment ever done ~~like that~~so well. Actually, he made two attempts at me; once in 1967. I had been at Trent a year and, in the middle of winter, he convinced me to go to Winnipeg, and we walked through this empty building that the University was going to lease ~~to them~~, and he Vallentyne told me about all the famous people he was going to recruit, and I thought this guy is crazy, so I didn't go. Then, a year later when I was ~~seriously~~considering moving, within days of accepting a job offer at Dalhousie, Vallentyne got wind of this and phoned me again and said, “Before you decide, you should come back here and have another look. I think you will be convinced that all of the wild things I told you came true.” And, so, I decided to take another look and he was right, it was an amazing place.

AD: So, what do you consider were the scientific achievements in your time there?

SCHINDLER: Well to start off with, this fellow Richard Vollenweider arrived with a 300-page volume under his arm that ended up being the basis of how eutrophication should be controlled. He and I had met two years earlier. Actually the first time I had met Vallentyne or Wally Johnson, the first Director of the Freshwater Institute, ~~was~~ at a symposium in Madison, Wisconsin, held by the US National Academy out of concern for this eutrophication problem that was causing algal blooms to appear on lakes around the world, including the Great Lakes.

None of us were invited speakers. Vollenweider, who was a very quiet Swiss, sat there with this huge volume which he shared with some of us while we were there, and Vallentyne ended up recruiting us both. ~~But~~ Vollenweider's theory was that the element phosphorus was the key to control. There was no proof; he had distilled ~~thies~~ evidence from about 300 other scientific works, ~~and~~ Vallentyne



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started pushing the International Joint Commission to recommend phosphorus control for the Great Lakes. He got huge push back from the detergent industry because their detergents were high in phosphorus.

So, they (the detergent industry) found a bunch of papers, which in typical propaganda fashion that they publicized very widely showing that carbon, not phosphorus, was the controlling eutrophication. So, one of the first things I did, being charged with this demonstration on a “whole lake” basis of what would work, was to test the carbon limitation theory. We had lakes that were so low in carbon that we had to develop new methods to measure it even. So, we thought, if we added phosphorus and nitrogen-nitrogen to those lakes, if they didn’t turn green, it would indicate that is to be true and the detergent industry was right. On the other hand, if the lakes developed algal blooms, but, if they did, that should be the end of the carbon theory.

And to make a long story short, we added phosphorus and nitrogen to a small lake, Lake 227, and got a huge algal bloom. What the industry had forgotten, and the first indication that one really needed to test management policy at a whole ecosystem scale, was that the atmosphere had all of the carbon that these algae needed. In a lake, carbon dioxide from the atmosphere invaded, resupplying algae, but and, by putting algae in little aquariums or bottles, the scientists working at small scales were cutting off atmospheric carbon, so, of course, carbon was limiting when they added other nutrients.

In short, we showed that invasion of carbon dioxide from the atmosphere is what solved the problem prevented carbon from limiting algal growth in whole lakes. That was the end of carbon theory but they (the Soapers, as we used to call them) were still resisting phosphorus control for because it was fundamental to their detergent obvious reasons, so we then did an experiment where we cut a figure eight shaped lake in half at the narrows, and we added nitrogen and carbon to both sides, but phosphorus only to one side and, again, we got a huge algal bloom in the basin supplied with phosphorus, and an aerial picture of that experiment was probably the first thing that made the Experimental Lakes famous.

I published the analysis of the data and the picture in *Science* in 1974; it’s been reprinted in hundreds of textbooks in almost every language in the world. To this day, I get several requests a year from textbooks to include it. It’s probably going to last at least a century. Jim Elser, in an interview a few years ago with *Science*, called that picture “the most powerful picture image ever taken in the field of limnology. That makes the Experimental Lakes well known. It turned out that my analysis of the experiment showed that it was another case where people had forgotten the atmosphere as a nutrient source. With the nitrogen, there is lots of nitrogen in the atmosphere, but it is all in gaseous form. One difference from carbon is that there is only one group of algae that can use gaseous nitrogen and that’s the very nuisance blue-green algae that we were trying to eliminate. So, trying to remove nitrogen from those systems we would be actually aggravating the eutrophication problem, and we have shown that repeatedly in variations on these experiments on the ELA lakes, up to my most recent two papers in the last years, showing this same thing. There are still a



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group of people who've spent their lives studying nitrogen, who don't like the idea their lives' work really yielded nothing of value for controlling eutrophication.

I've done my share of nitrogen experiments too, and adding it simply aggravates eutrophication the problem rather than solving it, because when nitrogen is scarce, the nuisance bluegreens thrive. The key to controlling the eutrophication problem is simple s-by-one element for a change; it's a "good news" story. Controlling phosphorus is relatively inexpensive, whereas controlling nitrogen is not. It isn't the most expensive solution that we need, and it's the least expensive one that will solve the problem. In ~~T~~that early era ~~at the time~~, our charge for Experimental Lakes was only to study the eutrophication problem, and those are the two lake studies that really got the world looking at the project ELA. The paper describing these mechanisms that allowed lakes to compensate for nitrogen and carbon are is the project's most-cited paper. It's been cited about 1,600 times in other scientific journals. To many people, Experimental Lakes still means nutrients despite high-profile work on later things, like acid rain and greenhouse gases, and, more recently, endocrine disrupters and mercury.

AD: So, what the Institute did was get the research evidence that could then not be denied and resulted in legislation and regulation.

SCHINDLER: Yes, and a lot of the credit belongs to Johnson who really was not a well-known Fisheries scientist. Most people would probably rate his career as middle-of-the-road, but he noticed that the International Joint Commission was reluctant to recommend a multi-billion dollar policy option; when all they had for evidence were a few little bottles. So he first proposed whole-lake experiments.

When Johnson ~~he~~ was a student, he had worked for a Fisheries Scientist in Wisconsin named Art Haessler, who had done some very convincing experiments in whole lakes, in that case, to make the lakes clearer by adding lime. How impressive whole ecosystem demonstrations were was really stuck in Johnson's ~~his~~ mind. It was his idea that we should have this facility to do whole lake experiments. Now, that being said, he and I really didn't see eye to eye on a lot. Vallentyne probably was the most effective referee we could have imagined. Johnson's idea was to do short term and very crude experiments; whereas, mine were to study all of the bio-geochemical processes. I could see where some of the processes were going to take a long time to cause the lakes to change. Vallentyne pretty well sided with me; and whereas, I had no ability to convince Johnson, Vallentyne did. He was really a useful go-between. And, then, after we started having this enormous success, Johnson sort of backed off and let me have my head.

AD: So, this was the first era in Canada of scientists, whether within academe or government research laboratories, looking at things that were detrimental to the environment, and to both the human and non-human environment. So, you began to affect regulations; you were part of that first era of scientists involved in the study of the environment and, then, regulation.



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SCHINDLER: There were some interesting things, in retrospect, in that early period that I just described. I only did science; I handed off the science to Vallentyne who understood the implications very clearly. Vallentyne dealt with the International Joint Commission and he also had Richard Wollenweider, the eminent Swiss who looked like Albert Einstein, right by his side; so, he convinced the Canadian Government that phosphorus control was necessary. However, the Americans were harder to convince. The EPA was just formed, in 1973, the same year that Canadians regulated phosphorus, and it was so weak that the American Administration decided that they were going to let states in the Great Lakes Basin make their own decisions on what nutrient controls to impose.

It was at the very era that we were being thrown kicking and screaming into the Civil Service and Vallentyne decided he wasn't going to be an administrator in that so he took a several year leave of absence and, before he left, he got me into his office and said, "Unless we get the Americans on side, this isn't going to work and you have to ~~do it~~ sell the science." So, my first exposure to being the front for the policy side of ~~this science~~ was really being thrown into these state-by-state hearings in the US where I had to confront their polished "traveling circus" that the detergent industry always brought along. And, thanks, to that one picture, I usually succeeded. That one picture said things to people who knew no science. They could ~~describe; they could~~ see beyond all the data that you could describe to them to see what happened with eutrophication, and why. It took 17 years to grind through all the states in the Great Lakes Basin but we ended up getting them all. The Great Lakes recovered for a while.

AD: So, then of course, that's when you really confronted various industries; it's the heavy metals and acid rain. Do you want to talk a bit about that?

SCHINDLER: At about that same era, once Canada signed legislation to control ~~off on~~ phosphorus and we became civil servants, we had a meeting one day at the Freshwater Institute where one of these new administrators referred to ELA as a "sunset" program, ~~and I said~~ asked, "What is a sunset program?" and he said, "You are done; we have no further need for you."

So, I thought about that for a while and I thought: ~~there~~ are other problems out there that need this whole ecosystem approach. We are probably making the same sorts of policy errors in managing other stressors. ~~Because of lack of considering these whole lake scales,~~ we would be missing important changes, as that we had ~~obviously made shown~~ with nutrients. I had a couple of allies in universities and ~~I won them in~~ one of them joined our ~~own~~ organization. ~~The one in our organization~~ This was Dick Beamish, who had just done his PhD on the La Cloche Mountain Lakes [Ontario] with Harold Harvey, documenting the rapid decline of fisheries due to acid rain.

Another ally was Eville Gorham, who was a Canadian at the University of Minnesota. Eville who had been working on acid rain since the 1950's. ~~He was~~ regarded as one of the fathers in the field and had documented acid rain effects on lakes it happening in Canada in the 1950's around smelters. ~~Also then~~ people like Peter Dillon Gilham, who is almost equivalent age to me, still a professor at Trent, then in his Ontario Ministry studies. He was head of their research program at the time.



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We had already been looking at the problem, because the Americans were claiming that a new power plant to be built at Atikokan, Ontario was going to acidify the Boundary Waters. There was a huge hue and cry, there and there was an international scientific panel appointed to examine the issue. I was appointed a member of it and we started looking at the data for acidifying emissions numbers. We and found that this puny power plant wasn't going to acidify anything. But, when we looked at the cross-border emissions, we were horrified by the high sulphur emissions coming across from the Ohio Valley and in the American Northeast into eastern Canada. They were higher than emissions causing acid rain in Scandinavia. The lakes in Canada were also more numerous and more sensitive. ~~so~~ I put all of the information ~~ose~~ together, took ~~it them~~ to our fisheries Administration and was accused of inventing and exaggerating the problem! So, we didn't get any money for work on acid rain.

This was my first connection with the Alberta oil sands. Their environmental science's program ~~had~~ just begun [the joint federal/provincial Alberta Oil Sands Environmental Research Program which was the environmental impact assessment for Syncrude] ~~and a~~ a younger colleague of mine, Ron Wallace at the Freshwater Institute, had been appointed as being in charge of this Alberta Oil Sands Research Project, which was first run by the Fisheries Research Board. ~~and,~~ Then, when the FRB ~~became~~ civil service, he continued. He said they didn't know what to do about the problem of acid rain in the oil sands. They knew they were going to have high sulphur emissions. Ron and suggested that I apply to them for research money.

Well, the Oil Sands funded work our in Ontario at ELA for three years. Similar work ~~it~~ couldn't be done out here in Alberta, because they had no roads or other infrastructure and things; just the budget to get around to lakes in the oil sands region would have been very costly. So, what we did was just one survey out here in the oil sands to document where the "acid sensitive" lakes where, and to confirm that the fauna and flora was very similar to what we had in Ontario. ~~and,~~ Then, we did the critical work back there [Ontario]. But getting that money was enough to get the civil servants seeing that there was a utility to the ELA this project beyond nutrients, so we got our mandate broadened. Actually, the Ontario representative who was appointed by the Ontario Government to interact with us was Peter Dillon, who understood both nutrients and acid rain and ecosystems very thoroughly.

So, it was easy to negotiate with Ontario and get license to do a broader suite of experiments. We actually broadened the ELA mandate ~~it~~ so that any sort of experiment could be considered. We would have to get Ontario's okay for our detailed on laying out a plan but it was not a very onerous process. We would also have to guarantee to recover any damaged lakes to their original condition, which has turned out to be an important part of ELA's research. We got that mandate extension, ~~in and think~~ the paperwork was finally signed in 1974, and we began our first acid experiment in 1976.

The approach for acid rain there was quite similar to what we had used for nutrients; ~~a~~ All of the work on acid rain at that time had been done on fish. ~~and,~~ a As a result of that, people around the world believed that lakes were endangered when they were acidified to a pPH of 5. We decided that



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maybe we should look at some of the other organisms in lakes and at pH values higher than 5, so, we took a broad community approach, and a similar broadanalogue approach on the bio-geochemical side, ~~and~~ ~~We~~ found that organisms started to disappear at ~~PpH~~ pH 6, which was 10 times less acidic than believed at the time. By the time we had acidified a lake to ~~PpH~~ pH 5, we had lost 50% of the original fauna and flora; ~~Some of that that the organisms~~ had been replaced by acid-tolerant fauna and flora but not very many.

The net loss of biodiversity was between 30% and 33%. ~~And, m~~ ~~More~~ importantly in the eyes of the Department of Fisheries, we showed that by eliminating two key items in the diets of Lake Trout, we caused the Lake Trout population to go into decline because they were starving due to the loss of key food species, well much earlier in the acidification process than if they had been affected, ~~first, only~~ by direct toxicity. ~~Trout had quit reproducing,~~ because they were starving. ~~They actually, these two species, one a minnow, the other a crustacean,~~ were important enough in the diets of their food of lake trout in these small lakes that to cause the trout to starve, d to the point that they couldn't reproduce. ~~So,~~ ~~Again,~~ we published that work in *Science*. We were also demonstrated, through the work on microbial activity and the geochemistry of the lakes, able to demonstrate another thing that was wrong about what people thought were underestimating the effects of acid rain on lakes.

One ~~thing of that era that one~~ heard all the time, "It's hopeless to try and recover acidified lakes because all of the buffering in their watersheds has been exhausted; therefore, they can never recover, at least for Geological Time. We showed that instead there were microbial processes, like sulphate re-production, that were responsible for a good part of that buffering, ~~and alkalinity that,~~ If anything the microbial processes werewas enhanced by acidification. The processes allowed so lakes to recover. ~~They couldn't recover all the way but they could~~ at least recover some of their ability to resist acidification. This finding, which sort of stripped away some of the excuses we were hearing from the USA on why they couldn't cut sulfur emissions.

The changes in ~~And, again,~~ working with regulators, ~~it was kind of funny were strange~~ in Canada, ~~we by now~~ Instead of the straightforward path from science to regulation we had enjoyed with nutrients, we now had to deal with ~~had this~~ the -strange Canadian political system where ministers worry not about science and sound policy but their image and their party's image. Things took longer, and policy makers they were not as receptive as they had been in "phosphorus days," but industry was receptive. There were only a few smelters and coal-fired power plants that were causing most of the acidifying emissions ~~problem in Canada. and, I think, T~~ to industries' credit, they left the governments of Ontario and Canada playing catch up.

If you look at the history, industry ~~****they~~ cut their emissions faster than ~~they were being~~ re ~~regulation~~ sed required, ~~and the numbers actually show that.~~ Every time industry would cut, the governments would have to play catch up. So, Canada again turned out to be a very easy place to get sound policy, with ease; almost no resistance on acid rain. In the US, there was huge resistance. The Reagan Administration had just taken power. In 1979, I was asked to chair a panel of the US National Academy, to look not only at acid rain but other pollutants spewing from smelters and coal-fired power plants, and their fate in the environment. A group of us, I think there were 14 of us



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altogether, spent two years doing that. We wrote a National Academy Report, a couple hundred pages thick that documented our findings all of this. There was one chapter on acid rain but it undercut all of the policies that the Reagan Administration was proposing. So, it became known as the *Acid Rain Report* and, in some circles, even as “The Canadian Conspiracy.” There were four Canadians on the panel including the chair (me)- Eville Gorham, who was a Canadian, but a professor at the University of Minnesota, Doug Whelpdale, from Atmospheric Environment Service and Tom Hutchinson from, at that time, the University of Toronto. This was viewed It was proposed that we had as some sort of conspiracy to shut down American industry.

On the American side, the response was to throw together this huge program to study acid rain, known as NAPAP [National Atmospheric Precipitation Assessment Program]. The program didn't give funding to people that who were established acid rain experts, people like Eville Gorham and Gene Likens, for example. They had all these new, inexperienced, shiny-faced people who, in typical scientist fashion, saw this big pile of money so wanted a part of it. They were starting from square one. So all these novice scientists were part of this NAPAP and it took a few years for them- to learn the science. I think the politicians were cagey enough to know that this would give them several years of breathing room. When the first NAPAP reports started coming out, they were not saying what their scientists were finding, and Ppeople Some of NAPAP's scientists started saying, “How come you didn't mention my work in the report; we showed these lakes were being acidified and the report executive summaries were claiming there was no acidification problems in the US.” So, there was a huge fussto do over this NAPAP program, that I got heavily involved in siding with the ignored scientists, in ways that are probably more or less irrelevant to this. It ended in me getting I got letters of reprimand from Fisheries for dealing directly with American politicians and messes like that problems. Over time, we forced ground the NAPAP program into producing an accurate summary of what had happened, down and the Americans regulated. It took about 10 years in this case, which is probably a more typical response for policy. I think we are in that sort of an even worse era even worse now with greenhouse gases and, to some degree, with mercury and other atmospheric pollutants.

AD: Now, you mentioned that you did venture out west with that acid rain study that received some funding through the oil sands. Which lakes in Alberta and what region did you look at?

SCHINDLER: Well, we did the detailed work in Ontario in our Experimental Lakes Area, but what we did in Alberta was to survey just a selection of lakes that looked like they would be acid sensitive in the oil sands area. And w We did surveys of, I think it was, 38 lakes of them, or something like that. The work was actually done by Ray Hesslein, who was a graduate student from Lamont-Doherty Earth Observatory, a part of Columbia University [insert university] in geochemistry, who had gotten his degree doing his thesis work at Experimental Lakes, and I was able to take Ray on as a post doc with this new oil sands funding, and assigned the survey at part of the problem to him, because this was right in his area of expertise. Ray He stayed on; he just retired as a Senior Scientist at the Freshwater Institute last year.

AD: What year was that?



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SCHINDLER: ~~I think~~ Our first year of funding was 1974, ~~could have been 1975 I think~~.

AD: would you say that was one of the first studies and a benchmark study looking at those lakes and the Greater Athabasca Region.

SCHINDLER: It was, and our conclusion was that there wasn't much of an acidity problem for the foreseeable future. Of course, at that time, one couldn't foresee that development was going to be projected to 5 million barrels a day. ~~I have forgotten what Suncor's original output was.~~ Syncrude wasn't even operating yet in those days, ~~but and~~ Suncor's production~~it~~ was some tiny figure, 12,000 barrels a day, I think, is what they began with. Sulphur emissions weren't really a problem and the lakes were not as sensitive as in the Precambrian Shield. We correctly identified the fact that, when one travelled farther, got up into the Precambrian Shield country around Fort Chipewyan and north of there and, on the Saskatchewan side of the border, there were sensitive lakes, but those were a long way from the oil sands. We are now just getting to the point that there is some real concern about those lakes from an acidification stand point.

AD: Now, from 1975 to 1985, the Alberta Oil Sands Environmental Research Program [AOSERP] took place and, of course, it was the first huge environmental impact assessment done for a so-called mega project. When you compare mega projects of that era, there is James Bay, which of course is Labrador, Northern Quebec and in terms of the areas that huge hydroelectric power project affected, flooding, etc., was huge in comparison to the footprint of GCOS/Suncor at that time. Were you involved in that at all?

SCHINDLER: I wasn't involved in James Bay, but I was involved a little bit in the predecessor of James Bay, which was the Churchill-Nelson diversion, which was not as big ~~a scale~~, but it was still a huge scale. It ended up cutting off almost the entire flow of the Churchill River, ~~pretty well~~, and ~~backing it up over land~~ flooding Southern Indian Lake into a channel that carried and flowing the water into the Nelson River, destroying Southern Indian Lake as an ecosystem, essentially, and the livelihood of the Native People that lived in the area. Part of the team that worked on that lake also ended up doing some work in the oil sands and a bit even on James Bay. There is a big volume of papers in the *Journal of the Fisheries Research Board of Canada*, in 1984 that documents those studies, ~~and~~ ~~it~~ They were a few years ahead of James Bay, and much of what was done on James Bay was copied from this Manitoba work.

AD: Now, from my research on the AOSERP program, over 19 million dollars was spent, which was large in those times and, I think, over 200 studies that related to natural species. The feds pulled out after two years so that it was, then, totally managed and funded by the Government of Alberta. Do you have any recollection of that and the pullout of the feds?

SCHINDLER: Yes. It's hard; because I ~~didn't~~ have enough familiarity ~~dealings~~ with the constitutional deliberations which were going on at the same time but that was in the same period, ~~that~~ ~~e~~ Constitutional changes ~~considerations~~ were devolving things that used to be considered as



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federal business to the provinces. The provinces were, for the most part, unprepared for the new tasks on environmental research.

I think that this constitutional devolution was a good part of the reason for the transfer of AOSERP to Alberta. ~~when,~~ Deduring the period I was talking about, the whole AOSERP program was run by federal scientists. If you look through the reports of that era, they are all done by members of the Department of Fisheries and some of their allies, and ~~it~~AOSERP was very successful. I think 1980 was the year the federal government finally pulled out and, at that point, AOSERP became~~it was~~ really embarrassing. Alberta didn't have the capacity to take over ~~those~~ studies, so they just handed out contracts to a whole bunch of consultants. Some of them were very good but some of them were not too swift. You can find very little of the work in documented form from that period. From 1980 till the end, there ~~were~~s a of couple summary reports. ~~One~~One was done by Ron Wallace, the same federal scientist who had run the AOSERP Program for Fisheries until after that the handover to the province~~change~~ was made.

Ron quit Fisheries and started a consulting firm in Calgary, so continued to do some of the work. He had an ally, a Fisheries scientist named Peter McCart and, in 1984, they put out a report on the Athabasca System that was a state-of-art report. It is~~was~~ about the only thing you can find from that era that is easy to find. I've got a few other things that were sent to me from consultants but they were report~~things~~ that I cannot~~couldn't~~ even find in the Department of Environment archives. So, a lot of grey literature, or black literature; I guess some of it wasn't worth saving even from that period. That pretty well continued until the end of AOSERP. I think the end of AOSERP was caused by hard times in the oil industry. The projects kind of dwindled away; for example, in the late 1970s, they were measuring some of the airborne materials that I always thought were important, but~~and~~ they quit in 1980 and 1981.

They Measurements of fallout of airborne toxins didn't resurface again until our 2008~~7~~ studies. They The oil sands went on to study other atmospheric emission~~things~~, such as pollutants that would be of concern for human health, but not these toxins that would end up back in ecosystems. I think ~~it~~the erosion of good monitoring was caused by~~was~~ the fact that ~~they were still being subsidized and~~ the cost of producing oil was very close to the price they were selling it forgetting, somewhere around the \$20 a barrel mark. I can remember when even in the 1990s, there was big optimism in Syncrude that they were going to be able to get their production costs down to less than 15 dollars a barrel, so they could actually make money. So it was a very strange period when funding was quietly stripped away because of these budget shortfalls because~~and~~ they weren't making any money.

On the good side, there were only the two oil sands plants and they weren't talking about expanding at all; so, damage to the environment was fairly localized. It wasn't until the late 1990's that the current craze to develop everything at once started to take hold.

The next good monitoring program was probably the Northern River Basins Study~~/Northern River Systems~~, It was initiated by the federal, Alberta and NWT governments in 1992. ~~It~~ studied the Peace, Athabasca and Slave river basins], but~~that~~ had a totally different emphasis that happened~~as a~~



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result of the Alberta-Pacific pulp mill being proposed. I was a member of the Hearing Panel for that. There were two federal members and, I think, five provincial ~~ones~~ members of the panel. Among things that I got interested in was the fact that this mill was proposing to use chlorine and bleach in bleaching, and the literature was starting to emerge showing that, below all these mills that used chlorine bleaching, there was a dioxin and ~~uranium~~ fluorine problem, and with bioaccumulation in fish.

Two of my colleagues at the federal government had been involved in that work, and I talked the Panel into inviting ~~getting~~ them out to talk to the Panel. That started a movement; Alberta Health then analyzed some fish and discovered that below the mill in Hinton and one in Grande Prairie, there was already a dioxin problem, ~~and Alberta Health closed several hundred kilometres of river channel, or~~ put a consumption advisory on the fish from several hundred kilometers of river, near pulp mills would be more accurate. So, all of this was happening during that era. As a result of all of that, the panel recommended against the mill until the river was understood better.

We went into this hearing not even knowing if there was a dioxin problem, ~~and~~ The real problem was that there were no studies of things like ~~that~~ dioxins in the river system at all. That wasn't about to deter our politicians of the day, ~~they believed~~ Al-Pac had ~~when they said something they had~~ told ~~our~~ the Panel that they absolutely couldn't operate without producing some dioxins ~~do, but after we recommended against the mill, that~~ they told the politicians that they could use a process that would produce no dioxins. The only test of the process was in beakers at a lab scale that, frankly, I didn't think was good enough to rely on to build a huge pulp mill.

The politicians jumped in and approved the mill on ~~the~~ at basis of the lab test; they had already subsidized building a railway and things in there so, I think, there was some financial embarrassment involved. The mill was told to go ahead but, as a sop to the Panel, this Northern River Basin Study was started to get a baseline study ~~ackground~~ on the river. The mill actually started operating halfway through the Northern River Basin's program, so it wasn't really background but it was better than nothing.

But the focus during that period was very much on pulp mills; nothing was happening in the oil sands. There was no indication the oil sands were ever going to become anything more than they had been since the mid 1970's. So, while there was a little bit of chemical work done in the oil sands area, but most of it was focused around pulp mills. The Northern River Basins's Study was a really good program in a couple of ways. Number one, if you look at the success, none of the mills on the river use chlorine to bleach anymore. The Al-Pac bench-scale thing ~~process~~ turned out to be successful. It sort of goes against the grain with me; it was kind of like playing Russian roulette with the river, but they lucked out; they were successful.

It is kind of amusing; there was a move by politicians of the day to try to get me fired, and things, because they thought it was all my fault that the Panel had decided what they did, because no body ~~else on it~~ other panel members knew any chemistry. When he retired, the first CEO of Al-Pac credited me with the reason why they went ahead and developed the dioxin-free ~~is~~ process. They were very proud that they had, and probably still have, tanks of fish in their reception area, which



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live in their pulp mill effluent, ~~and so on~~. As a result of the Northern River Basin Study documenting where these problems were occurring, all the mills on the two river systems were required to ~~stopget out of~~ producing dioxins. Actually, there were federal regulations about 1992-1993 that were the start of that process, and the dioxins in fish declined slowly. I think it was only about three years ago that the dioxin consumption advisories were lifted.

~~It is an example that t~~There is an occasional success story from environmental monitoring, ~~but t~~
The other really thing that was good about the Northern River Basin's was that although it was overseen by a big Panel, too big in many ways, but it did represent all sectors of society in the Basin, including the Native communities downstream. The Chief of the Cree in Fort Chipewyan, and another ~~from~~ Little Red River were on the main study board. On the Science Advisory Committee, there were actually three Aboriginal people, and the studies included with TK [Traditional Knowledge].

AD: And do you remember who those were?

SCHINDLER: One was Danny MacDonald from ~~Fort Smith~~, the NRBS study was actually expanded to include the Territories because there was already concern ~~for~~ the Slave River; Sonny Flett, from Fort Chipewyan, and later Lea Bill [Project Manager], who did a big TK study with Sonny for the NRBS board. Those people integrated and worked really well on both oversight and science boards. So I really don't see the problem with ~~the hesitation to invol~~ ing Aboriginal people more directly, whereas i ~~ch I see prevalent today they are~~ "consulted" but not really included. ~~It worked extremely well~~. Over the years, I don't think I've seen ~~a~~ boards work as well as the Northern River Basin's board and the Science Advisory Committee did, and the interaction between the two was really good.

AD: So, when was the Northern River Basin's board constituted in the studies?

SCHINDLER: I think the studies began in 1991, ~~I think that's when~~; I don't recall the exact dates but ~~the oversight board was~~ they were constituted and then the Science Advisory Board was added after that. I think there were five or six members of the latter initially. I wasn't initially a member; there were forces in government and industry that didn't want me to be a any part of ~~the study~~ anything in those days; but, apparently, there was resistance by the board and public demand that I be added, and I was.

AD: And that was what year?

SCHINDLER: That would have been the same year but later.

AD: Now, when did you arrive at the University of Alberta?

SCHINDLER: I arrived in 1989 in the fall, ~~and~~ I was told I didn't need to teach anything the first term. When I got the invitation to be on that Al-Pac Review Board, I thought it was a really good opportunity to develop an overview of the northern part of the Province, and the environmental



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problems that needed addressing. That was my main motive in accepting the position~~taking it~~, but I had been led to believe that the panel~~it~~ would only take one term. ~~and, In fact, it, and spinoff activities~~ took about three years and, then, with the Northern River Basin's involvement, several years more ~~than that~~.

AD: So, when did you become involved in oil sands-related study and what prompted this interest?

SCHINDLER: Well, through the Northern River Basin Study I saw all of the data that were~~as~~ coming in. I noticed that there were problems with the physiology of fish in the oil sands~~at~~ area, for example; there are enzyme indicators that fish are exposed to things like endocrine disrupters and immunodepressants, ~~and so on, and clearly that was going on~~ in the oil sands area. It wasn't known how much of the problem~~at~~ was from natural causes versus industry at the time; ~~so, at that level, keeping involved~~. - I was involved in a small way for a long time, as a member of various industry committees, or a participant in environmental impact assessments for new developments. I also got to know people in the northern communities fairly well. Some of them raised sled dogs, so we would meet on the racing circuit things, and I made some friends there. They invited me to be involved in assessing some of their environmental problems; Earlier, I had had a small dealing as a member of the federal government scientist with assessing the after-effect of Bennett Dam on the Peace-Athabasca Delta, so, I knew the issues there fairly well, ~~and~~ I represented the community of Fort Chipewyan in some hearings with the federal government which, at the time, was claiming the effects were not caused by Bennett Dam. They were all said to be caused by climate change, something that the Northern River Basins clearly showed was wrong. So I was involved in peripheral ways for a long time.

It wasn't until 2005~~7~~ when I saw how bad the monitoring work was. I had played a small role in the review of RAMP [Regional Aquatic Monitoring Program in the Regional Municipality of Wood Buffalo]. This was the program that started after Northern River Basins Study. It actually overlapped with the Northern River Ecosystems Study. In 1996, when the final report on the Northern River Basins~~s~~ was handed to the ministers, the recommendation was that it should continue. I think governments were getting a little bit nervous to see all the~~s~~ people power, ~~and w~~When you get mayors of pulp mill towns and Aboriginal chiefs on the same page, that's a red flag to politicians someone who wants to maintain control~~power~~. So, they scrapped the Northern River Basins Study, and; they rolled everything back behind closed doors and this Northern River Ecosystem Initiative, that most people didn't even know about. There were some reports from that, ~~that~~ The NREI lasted five years and there were, finally, some papers published recently.

AD: So, then, just to pick up on your work on the Science Advisory Board of the Northern River Basins study, that government kept cutting back on research and, I'm assuming, this is the Provincial Government. I gather that, in 2007, you had a meeting with then Minister of the Environment Rob Renner. Do you want to talk a bit about that?

SCHINDLER: Actually, I should go back a little bit further. In about 2002 or 2003, I had a meeting with the then Minister of Environment Lorne Taylor, ~~and~~ that came about in a strange way. The



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government was taking out full-page ads in newspapers telling people there was no human impact on climate,~~and~~ I wrote a letter to Premier Ralph Klein and got it signed by every Earth Scientist in Alberta in the Universities. I think there were 85 of us. We told Klein that his message on climate change was~~It was saying that it was~~ absolutely incorrect ~~..and sent that to Premier Klein~~. Klein and I had a long history of run-ins when he was Minister of Environment, and I don't think he wanted anymore. ~~and~~ ~~He~~ said, "Oh well, Schindler's been right before. I'll see he gets a session with my Minister of Environment."

I had never met Lorne Taylor so we made an appointment. I took Martin Sharp, who chairs Earth and Atmospheric Sciences with me, and we went to make a presentation to Taylor and his staff. We had an hour scheduled and, at about the half hour point, I could see Lorne looking at his watch. He kept interrupting us and asking questions and challenging us things. I thought ... "Oh, oh, we aren't going to get to our punch line on this" but, towards the end of our scheduled time, he called in his secretary and said, "Cancel the rest of my appointments for the afternoon; I want to hear all of this." So, ~~I think~~, we spent two-and-a-half-hours total and, at the end of it, I think we had Lorne convinced, at least. ~~He had,~~ ~~s~~ Shortly after that, he formed the Water for Life Program. He told us flatly, "Look I have to deal with people in Cabinet that I'm not going to convince of climate change this, and so on, but I'm concerned about what our big problems are," and of course water was one of our big problems. ~~But~~ Lorne and I became fairly good friends, not to say we shared political beliefs or anything, but at least he was not a blind ideologue like so many members of his party.

One day, out-of-the-blue in 2004, Lorne phoned up late at night and said, "Would you chair a panel for me ~~with Fisheries scientist named Peter McCart?~~" He said, "My staff gets terrible grief from people around the lake ~~[Lake Wabamun?]~~. They are always blaming my staff them for not doing enough. I know there is lots of literature on the lake. Would you form a panel and chair it?"

So, I said, sure and got the ~~his~~ panel formed and ~~We~~ came up with a little report, that I still have a boxful of sitting there behind my desk. In late 2004, I handed it to ~~the~~ Minister Taylor, who was quite surprised. People were determined that all the problems of the lake were caused by the coal-fired power plants. We found the biggest problem was people and their treatment of beaches, cutting vegetation, taking out snags that provided fish habitat, dumping in sand to make bathing beaches and so on.

~~He~~ ~~They~~ said, "We will never be able to convince people of that."

I said, "You arrange the meetings and let me convince them," which I did. They got one complaint and I dealt with that complaint. I didn't hear anymore.

The next summer, we had a change of ministers to Guy Boutilier, whom I'd known from Northern River Basins days, when he was then Mayor of Fort McMurray. We had actually roomed together a couple of times during the NRBS, when he was a member of the board. We used to have meetings in places like Jasper that were tight for rooms, so I had shared a cabin with him a few times. One



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day in early August, he phoned up and said, “We’ve had a train wreck on Lake Wabamun, will you help us?”¹

So, I got involved in Lake Wabamun and, then, in building the case against CN. The Department of Environment They put together a group of experts which included the person ~~that~~ who had done the chemistry for the Exxon Valdez studies, Jeff Short, and a toxicologist ~~who~~ that had done a lot of work in the oil sands, Peter Hodson. ~~So,~~ it was in those meetings that we started looking for comparisons to make with Lake Wabamun and, of course, the obvious ones were the oil sands and the Exxon Valdez. Well, in a lot of the calculations, what looked like the biggest problem was the oil sands.

AD: So it emerged from that.

SCHINDLER: It emerged from that. ~~and I took these issues, but then~~ We had another change in Minister of Environment to Rob Renner, ~~but~~ By then Lorne Taylor had left politics and started ~~the~~ Alberta Water Research Institute, ~~for which~~ ~~where~~ ~~re~~ ~~ch~~ he invited me to chair the Science Advisory International Review Committee, so I got to know Renner pretty well ~~in the midst of that~~ because ~~he~~ Renner would attend at least the initial receptions for AWRI meetings and things. So I arranged to have lunch with Renner to tell him all my fears about what was happening in the oil sands and what needed to be done. ~~Of course he wasn't going to hear any of it, and h~~ He had two of his lieutenants along; one of them a really dense guy who had determined that they had everything covered, and convinced Renner that there was no problem. So Jeff and Peter Hodson and I decided we were going to do our own study in the oil sands area. We raised the money from ~~two~~ foundations the Walter and Duncan Gordon and Tides Foundations. ~~Erin Kelly who had done her PhD with me on mercury a few years before and had gone off to work for a consultant, had found that was not her calling. So, I hired her back as a post doc to do the field part of the program, and the rest is history pretty much.~~

AD: I'm going to ask you to give me more details about this, but I gather that you went to the Environment Minister Rob Renner claimed that their studies had ~~with~~ 4 million data points that refuted your findings.

SCHINDLER: His response to me ~~is~~ was that “We have 4 million data points on that river and they show that there is no problem.”

AD: What were your points that you made to him?

¹ An oil spill occurred: “At 5:40 a.m. on August 3, 2005, 43 cars of a Canadian National (CN) freight train derailed near the Whitewood Sands subdivision, spilling up to 1.3 million litres (286,000 Imp gallons or 343,000 US gallons) of heavy bunker C fuel oil. An estimated 734,000 litres (161,500 Imp gal/194,000 US gal) of the thick, dark material was spread by high winds across 8 kilometres (5.0 mi) of the surface of Wabamun Lake.” Wikipedia: URL: http://en.wikipedia.org/wiki/Wabamun_Lake



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SCHINDLER: Well, number one, that I had chaired at this US National Academy, ~~a~~ panel which had reported on airborne pollutants in 1989. ~~that was~~ We did not find a single smelter or electrical plant that burned fossil fuels that did not put out pollutants into the atmosphere ~~and~~ that re-entered ecosystems. ~~Because the~~ oil sands upgraders were smelting ~~this~~ bitumen at 500 Celsius and using “petcoke,” a quite dirty coal-like fuel that was a residual of bitumen extraction, it was very likely that they were putting ~~them~~ out pollutants that ~~and~~ they ought to be measuring. ~~And~~ ~~the~~ other main point that I made was that watershed science was developed well enough that one fundamental was: ~~that~~ you do not strip watersheds of their vegetation and soils, and expect the chemistry of runoff to remain the same.

When you expose fresh geological substrates and rain and snow ~~fall~~ on them, every chemical in that watershed goes ~~went~~ up in runoff. Others had shown that, even disturbing a few percent of a watershed, caused ~~runoff of contaminants~~ ~~them~~ to go up, ~~and~~ ~~here~~ we were with some tributary watersheds in the oil sands region being which already at that time were 20 and 30% stripped.

I made the case that there was something wrong with monitoring that could not see if we are not seeing these things and I knew from a small role in the initial RAMP Review that RAMP was using some pretty insensitive methods. ~~For~~ ~~and~~ some things, for example, they were sampling once a year, and breaking all sorts of fundamentals of monitoring science by. ~~Changing~~ their sites and changing their methods, changing chemical contractors without any ~~inter~~ calibration between the methods of the two. ~~It's~~ like they had read the rule book for how to monitor and decided to violate every principle.

So, those were some of the main points I made at the time; ~~but~~ they fell on deaf ears. From a politician's standpoint I feel kind of sorry for Renner in that he was getting bad advice from the people that should have known better, ~~who~~ Some of his advisors were coming on very strong when they really knew nothing about monitoring. ~~They were~~ in way over their heads.

This, of course, has been the history of Alberta Environment. They like to pretend that they have contenders in the science horse race but they are usually running Shetland ponies, and they try to make up the difference with lots of propaganda. It's time they hired a few really good scientists and gave them their heads on what things to ~~do~~ study. They used to have a few but they have pretty well all retired now, or near retiring. The department is ~~are~~ replacing them with a lot of new, “green” Masters' students, and ~~so on~~ people with little or no science background. I think the worst of the lot are the ~~military people~~, people with military backgrounds; they seem to get fixated, whether they've been told directly or not, that their job is to make the minister look good and, if the minister would like to see a river without problems, that's what they will tell him he has. One might call it the “Charge of the Light Brigade” syndrome. It's the same thing I see in the federal government, ~~if~~ ~~if~~ you want to get promoted, you curry favor with your boss, by telling him what he wants to hear. ~~and~~ ~~its~~ a way of promoting people I really have no use for. I ~~just~~ think that, when a minister is stepping in to deep doo-doo, somebody ought to tell him. Who needs friends that are going to let you fall on your face? ~~and~~ ~~Essentially~~, I think that was what happened in Alberta.



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AD: So, you initiated your own study and I want you to go into that in detail - when it was initiated and who was involved; what did you do; and then what were the outcomes?

SCHINDLER: Okay, ~~the~~ one part of the program that we knew exactly how to do, because we had ~~a couple of dry runs for previous experience~~. We knew the easy-and-cheap way to find what was coming out of stacks; and ~~knew exactly how it was~~ getting back into the environment, was to study snow. I've done that going right back into my early days at ELA, and had seen it done successfully in Scandinavia and Northern Scotland, and Eastern Ontario, and all over, ~~so that approach was~~ It's an easy ~~way one~~ to examine air pollution.

The water pollution side was more complicated. ~~We~~ couldn't figure out how the province could only be sampling at the mouths of rivers and be telling people that industry was doing nothing! In fact, they were sampling there with very insensitive methods that they could not see what industry was doing, ~~and~~, Even if they had sensitive methods, ~~they were below everything, samples were taken downstream of both~~ natural sources and industry sources. It was nonsense to claim that you could distinguish them!. We did ~~a~~ GIS mapping of the whole basin containing with the McMurray Formation which contains the bitumen, ~~and then~~ We designed our sampling program around that so that, on every tributary, we had a sampling upstream of the McMurray Formation, in the McMurray Formation, but with no or minimal industry, and the final one downstream of industry.

Actually, we had planned it for ~~no~~ the second sample to be upstream of above industry and then a third one below industry. We found out, when we got around to sampling, we designed all of it our program based on 2006 GIS photos. ~~We found the horror when we started the program, a~~ After our first sampling in early 2008, a new set of GIS maps. ~~The 2008 ones~~ came out, and a lot of our sites that we thought were free of industry had been developed in that 2-year period in between. So, our study ~~it~~ ended up a little more messy; we had to settle for examining less than 25% disturbance vs. more than 25% rather than all or nothing, ~~but it still showed the same thing~~ Even so, there was a clear signature of industry.

One key to what we did was that we copied the chemical methods that had been used by the Exxon Valdez [scientists]. They had developed a way to integrate samples of these polycyclic aromatics compounds (PACs) by exposing a piece of special plastic membrane, and then extracting the PACS that clung to the membrane, and calibrating those and using that as an index. It was 1000 times more sensitive than the methods being used at RAMP and by the Province. So, that was the key to the polycyclic aromatics. Sampling for and the trace elements were pretty standard except that we used super-clean methods. Erin Kelly had developed similar protocols for her mercury work as a PhD student. ~~She had~~ These special protocols were used for sampling other metals ~~that were suitable for all as well, and~~ Analyses were done by Queen's University and Royal Military College, which had certified chemical laboratories, ~~so we knew that our results would be challenged, so we had all of our analysis done there by these certified laboratories~~ so that there would be no question about the quality of analyses. We worked up the data and published them, ~~they~~ Actually, the studies were kind of boring. ~~They didn't know the amounts, w~~ We knew we would see something, given the extent of airborne emissions and watershed disturbance. The question was how much



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industry had added to natural sources, not whether it had. Some of the right-wing journalists ~~were~~ shocked when I say we knew what we were going to find, as though this somehow means that you are-we were biased in what you we found. But it would have been a surprise not to see anything after all the similar studies that had been done before ours. It was more a question of how far afield we would find the contaminants, and what quantity.

AD: So, can you tell me about the findings?

SCHINDLER: ~~Okay, so~~ The snow results were the easiest to interpret. We found that there was a bull's-eye pattern converging on the two bitumen upgraders, which are right across the river from each other. Everything from polycyclic aromatics to trace metals fell away from that site in a pattern, ~~that~~ We could detect a difference from background values out to 50 kilometres away, in the directions that we studied. It would have been nice to do a “wind “rose” type” pattern ~~and all sorts of fancy things; but~~ we didn't have the money to do that. We were restricted to sampling where we could get ~~to and land with~~ land a helicopter ~~and things on land not controlled by an oil sands company.~~

Environment Canada has since copied our studies and done three times as many sites, and they are getting the same similar results. We weren't out to get an accurate precise measure of what was going on; we were out to demonstrate that more work needed to be done to characterize what industry was doing in the area. ~~So, that~~ That was fairly easy to do.

We were attacked by some industries' consultants, ~~that who~~ claimed that what we were seeing was just blowing dust from the mines; but it was obvious that it was not blowing dust. For one, the polycyclic aromatics ~~onto~~ particles in the snow were in concentrations several times higher than in the richest bitumen in the area; so it couldn't be blowing dust. What was happening, we're pretty sure, is that volatile pollutants were emitted from the stacks in a gaseous form. When they and hit a cold winter atmosphere at Fort McMurray; a lot of them condensed.

These things (PACs) behave much like water; they can be in a vapour phase at one temperature and, when they are cooled slightly, they condense. ~~with e~~ Every compound has ving slightly different vaporization temperature characteristics. ~~in that regard. But~~ They are also what are known as “hydrophobic,” and that is, if there is any organic solvent or organic particle around, the pollutants it will move out of water to that other substance. So, when PACs they get into the snow, any little particle, soot particles or pieces of tree or anything, they migrate to those particles present in the snow. The big concentrations in snow were in the particulates and those particulates were way higher than blowing dust could have been in the area.

There were some fairly simple answers that we had to ~~some of those things and, again, the question of pollution from the oil sands industry.~~ The big breakthrough on getting our results accepted. I think there is credit that needs to go to two politicians: one is Ed Stelmach who when the controversy erupted and his minister and his minions were denying that our studies were correct, said, “Well those people have been correct before; maybe, we should have a closer look at their



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results.” I read that in the papers and immediately sent Stelmach an email saying, “I think that’s a great idea. Why don’t you go to the Royal Society? Here is a list of people that know environmental chemistry and oil sands in the Royal Society who’d be good members.”

I didn’t get a reply to that for several days but in the meantime, I got a phone call from Jim Prentice’s office. He was then the Minister of the Environment, federally. ~~He~~, ~~asked~~ if he could come out and go through our results. So, ~~his staff~~~~they~~ proposed that I meet with them at the airport. He was on his way to some meeting in Calgary, ~~so~~ Erin Kelly and I went ~~to the airport~~~~down~~ one evening; took a computer with all of our graphics and ~~picture~~~~things~~ on it; and spent two hours ~~briefing Prentice~~. It was obvious by the end of the two hours, he knew that we weren’t wrong. He again asked our advice on how to handle this, so I made the same suggestion to him as I did to Stelmach, and he acted first. He had ~~an expert~~ panel formed the next day with really eminent people on it. ~~I think~~~~thought~~ it was about a week before the Province responded, ~~and, what~~ Stelmach had ~~done, he had~~ been off at some meeting in Washington and so didn’t respond for a few days, but he handed the problem off to Rob Renner, ~~his Minister of Environment~~~~so~~. Renner then handed it off to his ~~staff~~~~people~~ to setup. Since I had given ~~both Stelmach and Prentice~~~~them~~ the same list of names, some people wouldn’t be on two panels so ~~they~~~~province~~ substituted some Americans, and so on.

They were both really good panels and they were given slightly different charges. The federal one was simplest - yes or no, ~~are we doing~~ ~~is~~ an adequate job of monitoring ~~the Athabasca River~~ was pretty much ~~their charge~~~~it~~. The provincial ~~panel~~~~one~~ was charged with comparing our data to the RAMP data and the province’s data. Both ~~panels~~ came to the same conclusion: that the monitoring was substandard, and that we had been right in our claims ~~about~~~~on~~ this. Then, in the same period, ~~there was~~ another RAMP review that was reported, ~~which pointed out many shortcomings in that program~~.

The Royal Society Report ~~also~~ said that monitoring wasn’t good enough in the ~~oil sands~~ area, and the Auditor General had a report said much the same thing. So, suddenly, in a space of several months there ~~were~~ five reports ~~criticizing~~~~knocking~~ ~~their~~ monitoring of the Athabasca ~~River~~ in addition to our two papers. At that point, I think, Renner was rather painted into a corner. So, he formed yet another panel, to devise a world-class monitoring program, and I thought he put together a rather odd panel, because it was about half scientists and half business people, and most of the scientists weren’t people who were the gurus of monitoring. But, they included people like Ron Wallace that headed the AOSERP program. Our Dean here, who at least is an environmental scientist; Joe Rasmussen from the University of Lethbridge who does have a good familiarity with monitoring and river fishes ~~and so on~~; and this collection of business people. But the business people, to their credit, really saw what was going on, ~~and~~~~+~~ Their main recommendation was that people had been jerked around so much by both levels of government, ~~who were~~~~and~~ substituting propaganda for real science, that ~~future~~ monitoring needed to be ~~overseen~~~~run~~ by an independent group.



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So the Alberta Environmental Monitoring Panel (AEMP) ~~at so-called AEMP~~ report was filed in late June of 2011. Renner released it early July and said that he would act on it right away. ~~Well, then,~~ Stelmach stepped down and we had a leadership race and Renner supported the wrong candidate, so Renner lost his job. We had a brand new minister, and there was silence for a long while, ~~and~~ I thought this was reasonable. The current government had run for election on health care and education, nothing on environment. I thought they would try to scramble to look good on health care and education first, which they did. Members of the AEMP ~~INK~~ panel were getting kind of cranky; some of them were also big Conservative supporters. Some of them probably would support Wild Rose if given the choice. I don't really know any details. But, through some of my contacts in Environment, it was reported that they were beginning to ask the Minister, "Are you going to act on our report?" Some of these people don't like to waste six months of their time only to have another report quickly thrown into the wastebasket.

Another paper that we put out at about that time seemed to have the necessary catalytic effect. A student of my wife's, Rebecca Rooney, ~~had~~ had done her PhD thesis working on wetland reclamation in the oil sands. So, and she and Suzanne and I published a paper using pieced together a pattern of GIS-based reclamation maps to compare what companies that they claimed they could do versus what they were actually planning to do. We, and pointed out ~~again what that what~~ they were telling people on TV was not evening close to either what they were filing as closure plans to what they were going to do or what they could do.

~~So,~~ I sent a pre-print of that paper to the Minister [Environment and Sustainable Resource Minister Diana McQueen], and I also sent a pre-print the day before to members of the AEMP ~~INK~~ panel. One of them, I'm not sure which one, apparently phoned up the Minister and said, "See I told you, you should have acted on our report; you are going to look stupid again tomorrow." So, the minister phoned me up. I didn't know what had gone on behind the scenes at that point, ~~and~~ She asked if I'd come in for a meeting. So, I went in for a meeting and she said, "Look, we haven't gotten to this as we have only had a few months since the election, and we have been focusing on what we promised (health and education reform). We and realize that we have to act on this. I really don't think we have enough in the AEMP's report; would it be reasonable to form a group to flesh out their is report with and make some specific recommendations?" I said, "Yes." So she formed a working group with this panel more or less the same membership as AEMP, since they were already familiar with the issues up to it and I agreed it was probably a good choice at that point.

AD: What was the name of this panel?

SCHINDLER: I don't recall their title. They insisted on being called a working group rather than a panel. They thought there were too many panels, ~~but then~~ They recommended at the end of July 2012 what the Minister should do, but the recommendations, they weren't released until October. It is rumoured that the Minister had some fairly big fights in Cabinet to get their report at accepted; those are just rumours. I really don't know if there is any basis for that rumour. But she apparently won because, in October, finally, she had accepted their is report, released it. It contained two or three options for funding mechanisms, and it recommended again that governance is has to be



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independent and how that might be done. ~~and so on; and~~ She asked the same group once again, “Will you go back and make one specific recommendation for funding,” and ~~so~~ added a couple members to the working group panel. They are still meeting.

AD: But you are not a part of this?

SCHINDLER: I haven’t been a part of any of this, ~~but which~~ I can understand why I wouldn’t be, given the petro-politics today.

AD: But at least they are taking seriously the findings.

SCHINDLER: They seem to be serious but they are slow. I have had a few one-on-one sessions with the Minister. I think I’m fairly good at reading people, ~~and~~ I think the Minister is sincere. I think the Minister is getting messed around a bit by some of her senior bureaucrats; it’s one thing for a Minister to give you an order to do something; if you don’t really believe in it, you drag your feet.

I think that is kind of what is going on and I’m fairly nervous what the outcome might be as a result ~~though~~. This working group still contains some people that I think are level-headed enough to know what needs to be done. What I fear is that there will be some mechanism proposed with the illusion of independence but not real independence so that there will be some senior bureaucrat allowed to filter what monitoring information is allowed to be ~~is~~ publicly visible.

AD: Now, I want to go back to the report findings, where you focused on the part of the oil sands plant, the hydrocracker or whatever, that element where you are using a hydrocarbon fuel because heat is needed for the process, and that then this creates air pollution. You talked about a bull’s eye or bulls’ eyes around the major mining extraction operations, Suncor and Syncrude. How extensive are those bulls’ eyes; just give me a sense of the terrain covered?

SCHINDLER: That is a really good question. We could see ~~the~~ footprint of the upgraders in snow out to about 50 kilometres and I’ve seen the Environment Canada results. The lady who’s doing the work used to work ~~live~~ right across the hall from office, as; she was one of Vince St Louis’ PhD students. Her snow results; for Environment Canada, are almost identical in pattern to ours.

There is a puzzle though in that ~~at this~~ recent study of lake sediments that was just published about six weeks ago can see the polycyclic aromatics travelling twice that far. It would be fascinating to look back and to try to devise a new program to figure out why that would be. My guess is that it’s something like, ~~these that volatile~~ pollutants are travelling twice as far in summer as in winter. ~~to travel as far~~ ~~In~~ winter, they are released to an ~~hitting that~~ atmosphere that at Fort McMurray probably averages at -25 C ~~or something in the wintertime~~. They are in volatile form because they are emitted at about 500 C, and a lot of them probably condense and rain out near the plant in the winter time. In the warmer summer atmosphere, they are probably carried farther afield. ~~because they were clearly finding things out to~~ At 100 kilometres from the upgraders, deposition was that were two-fold higher than background. They study used ~~had~~ a new fingerprinting technique to



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~~separate sources of contaminants; Environment Canada developed a new method of separating petrogenic chemicals from the stacks versus results from combustion from forest fires, and things Combining both sources that had kind of muddled the picture in the past earlier. They technique were able to show clearly that these upgraders were the source.~~

AD: In terms - I asked that question about the extent of the spread – because, when you look at volcanic eruptions and other kinds of things, forest fires; the atmospheric conditions can scatter these enormously. Think of the Iceland eruption, all of Northern Europe, but these are discrete so that's a part of the correlation as to the source, right?

SCHINDLER: Yes, I think the one exception among the pollutants that we studied to limited spreading is probably mercury. We were able to detect this same distribution pattern in snow for mercury but, when we did the calculations, we only accounted for a small percentage of the mercury that was emitted from that stack, ~~which they report according~~ to the National Pollutant Release Inventory, ~~which This~~ means that the bulk of the mercury is being carried farther afield.

~~Whether mercury is in vapor phase is not as Now, mercury is something that isn't as~~ temperature sensitive as these polycyclic aromatics. It's known that, once it's in gaseous form, ~~mercury~~ can be carried across the oceans, ~~and it's~~ widely recognized that the global background - because of burning fossil fuels and smelting - is now 2-3 times what it was before in pre-industrial times. So, these upgrader stacks are adding to that much bigger, more global or broadly regional pattern that we see with mercury, rather than having an effect only near the oil sands ~~this pattern that is exclusively on site~~. I think mercury, of all things emitted by the oil sands, is up there it's my biggest concern because it's too high in fish for people to be eating most species of fish right now. Any emissions that would make it higher ought to be controlled, ~~and it~~ The good side of this story is that, if there are any politicians with enough will, there is enough technology there to curb most of these mercury emissions right now; it's just a matter of requiring companies ~~them~~ to use it.

AD: That was going to be my next question, because you look into the early 1980s, the conventional industry was allowed to flare. And, of course, after every rainfall you would see the yellow edges on puddles and so on, because of the sulphur. Of course, regulations forced them to deal with that; in other words, this science is providing answers like your initial freshwater studies. Good science is necessary for remediation isn't it?

SCHINDLER: It is, and one of the arguments that I keep making, and they keep forgetting with respect to oil sands, is that we have the technology to see pollutant concentration ~~things~~ starting to edge up, ~~in these pollutants at much~~ Knowing rates of increase at lower levels; ~~then,~~ they are known to be toxic allows us to plan for cutting back emissions before toxic concentrations are reached, and that's what we want [to know]. We don't want the approach that we hear all the time from the Government, "Oh, it's ok because none of our guidelines are exceeded." When you get to the point that guidelines ~~they~~ are exceeded, you are faced with the analog with putting toothpaste back into a tube. The time to deal with pollutant emissions ~~it~~ effectively is, I think in this case, ~~you want to see it~~ decayed before toxins are it's going to become a concern ~~happen~~. The reason being



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there are a couple of billion dollars invested in an oil sands plant; it takes 10 years or more to get ~~on them~~ from the planning stage to producing oil. There isn't a nickel of profit seen until that point is reached. The last thing you want to do is ~~go through all of this, and to impose a new regulation at the point where a company is just beginning to produce, that you start emitting, now, you are faced with having to regulate.~~ The earlier we can see when ~~these~~ regulations are going to be necessary, and start incorporating that into the planning and development of the industry, the more money we are going to save.

AD: And, to go back to the Al-Pac example that you gave that they really were proactive. You weren't sure about whether their test-tube calculations were going to be realized in the field but they were and, so, the scientists in the research establishments and academe are not actually saying stop everything; they are studying and providing opportunities to resolve these issues and make the processes more effective, efficient, and less environmentally damaging.

~~Now, I think~~ that's my sense of it, and I have been following this for years, as you know, as a Science and Technology editor for the *Canadian Encyclopedia* - that first generation of environmental scientists and I also edited the industry articles as well. With these snow studies, you basically identified air pollution; whereas, previously everyone was looking at water pollution and seepage from the tailings ponds, and everything else. Of course, particulate matter does end up on watersheds and end up in the water supply, no question about that, but the water pollution potentially from seepage was always viewed as the higher danger I would say. Do you want to talk about that?

SCHINDLER: Yes, I would say that the one reason that we ~~studied~~ snow was because it's inexpensive; you can get four-months of deposition in one measurement. Another thing that is nice about it is ~~that~~ nobody is going to argue that the pollutants have come from anywhere else. They don't miraculously appear; they are in a tight pattern around the source. ~~I think that, when you start to look at the~~ With water, you have to be able to separate ~~get a situation that is muddied by having~~ natural sources that everyone recognizes that are there, ~~from~~ with industry ones, and they can be difficult to ~~you can't separate them out.~~

One thing that has saved the Athabasca and saved the industries' skin is that ~~they have an average of~~ 700 cubic meters per second, on average, of clean water from upstream of the oil sands is diluting away any toxin ~~anything~~ that they're putting into the river, so that you expect it to be below guidelines.

~~Now,~~ I don't think there has been a thorough enough job ~~of~~ monitoring any of the tributaries. My prediction is that the first detectable ecological damage in that area will be found in tributaries like the Muskeg River and the Steep Bank, particularly the Muskeg, which is being hit hard by several developments now. We have to look at those, not only as sources of contaminants to the main Athabasca, but also sources of fish. The Muskeg for example, produces several thousand fish every year that run back and forth into the mainstem river, so they are part of the population that people are using for subsistence, downstream. The last thing we want to do is cut off those sources



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of fish to the river; They are important; we don't know how important because the studies haven't been good enough.

AD: So, this is a direction for further study and since we are moving in that direction, what studies would you like to see done?

SCHINDLER: ~~Okay, I think to their credit [garbled word] can you verify what this should be] didn't really follow up.~~ After the federal report, the Minister immediately followed up, acted and got Environment Canada to put together an expert group to improve its monitoring in the oil sands. They had that plan ready by the spring of the following year. You can actually see the plan on the web and they started to execute it. ~~T~~And it's their execution of the plan in 2011-2012 ~~that we are now seeing~~ is vindicating some of our findings. They did a really good job of responding scientifically; however, the Minister promised in February of 2011 that industry would pay for that monitoring. But and tax payers are paying for it to date.

~~I have i~~Independent sources that have given me some estimates that government is they are putting around 20 million dollars a year into that program. They are cutting every other Canadian program that Environment Canada has to show the flag in the oil sands. ~~and, d~~Despite all of the on-paper appearances, there is no federal/provincial co-operation on monitoring going on there, which I can understand from a scientific standpoint, as Alberta is greatly understaffed. It's something that I hope an independent panel will correct. The senior scientific expertise working on that river is clearly all federal at this point. If a realistic politician would say, "Well we are going to be up-to-speed and doing our part in five years, and part of our federal/provincial agreement is we are going to do some capacity building here," there is no reason why they couldn't eventually have a provincial group that would be as good as the federal group. In fact, I am concerned that the federal group might not continue to be as good; a lot of the people running that program are the same ones who ran the Northern River Basins Study, and most of them are within a few years of my age. I don't see the recruitment of young talent in many areas that is necessary to have a successful program continue; and, when I see things government like their salary scales, which are is poorer than universities, ~~then,~~ plus the onerous things like all these muzzling of scientists things they are doing, I don't think a talented young scientist is going to want to work for a federal or provincial government agency, and that is tragic.

AD: Now, in terms of oil sands development, we've seen the shift to SAG-D technology and, of course, the resources of bitumen that are accessible via surface mining (strip mining) methods are limited.

SCHINDLER: They (mineable areas) are 99% allocated right now.

AD: Exactly. The future is going to be SAG-D technology and that the discussion that is being seen in the media is really about pipelining diluted bitumen to whether it's the United States or whether it is to the Pacific Coast. I'd like you to talk a bit about that, about any environmental concerns around the SAG-D plants and get into the whole pipeline debate.



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SCHINDLER: Okay, well to start with SAG-D, I think the best-known environmental issue part is not the aquatic part at this point; it's terrestrial. I've got a good group of colleagues in this department that work in that area, and it's pretty clear that the development is destroying too much habitat to maintain Woodland Caribou, for example, or any of the large predators, except for perhaps coyotes. It's really restricting the diversity of that area. Things like Caribou - I see a link there to our Treaty guarantees to Native People. Woodland Caribou were a good part of their diet. So, now, we have mercury-contaminated fish; we have fish with deformities that make people not want to eat them, regardless of whether they might be too contaminated or not. We have also cut off the Woodland Caribou. These are unacceptable to a society dependent on wild animals for its protein.

An invisible factor - I think there is big competition of oil sands workers with Native People for the same subsistence resources. I have canoed on that river. As far down as the delta, you can hear the engines of pickup trucks and ATV's at night. There is a network of trails everywhere. White recreational hunters and fishermen are targeting ~~the~~ the same resource base that provides subsistence for Native People. ~~isn't there. These resources guaranteed by treaties are~~ disappearing.

The SAG-D has one thing in its favour; it doesn't leave an enormous pit, so that the same degree of surface reclamation as mines isn't necessary. However there are pipelines, roads, well pads; you look at the landscape afterward and then the disturbance around that the industry and it is a mess. ~~It's~~ widely-recognized in several studies ~~now~~ that the Caribou ~~are~~ trying to calve or rear their calves are not going to go within 500 metres or so of something like a well pad, or a heavily used road. So a lot of their habitat is simply gone. I really think we are developing ~~going~~ too fast. ~~and w~~ What we should be doing is relying less on oil sands ~~that~~ development; doing it slower with a very stringent requirement for restoration before the next parcel of land can be taken. I think we are going to end up without Caribou in that area. ~~the handwriting is already there and it would be already very~~ It would be difficult to turn that damage around.

~~Q~~ Now, on the water side I think there are going to be problems. It is Hhard to see where there would not be problems when you pump steam underground; melt the bitumen with all the contaminants; and flow it down to a level where it can be collected in another pipe. Their extraction efficiency is generally less than 50%. So, that mobilized bitumen and its contaminants are going somewhere, probably into aquifers. It moves slowly in aquifers, so we might be creating problems that we won't be seeing for a decade or two. ~~T~~ So, that part of the problem is not well enough studied to know.

And, then, there is the pipeline question. I think my big concerns there are economic ones. We were told a few years ago that the US was our this valued customer who was going to take all of this synthetic oil. ~~And t~~ Then the Americans fracked and found they had enough oil and gas, and now they're talking about becoming the number one producer in the world of gas. ~~Now, s~~ Suddenly without warning, we have this emergency call from politicians to run a pipeline to the coast so we can send the bitumen to China.



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There are these fracking pools happening all over the world, aren't there any in China? I worry a bit that we will destroy a lot of wilderness and run a pipeline to nowhere, where we get there and find the Chinese really don't want our product either, at least at a price that we would like.

~~I don't want our oil either. Or I~~ The fantasy is that they will pay us a world price for it; whereas, the nasty Americans won't. I don't see any guarantees of that either. The price they are talking about in the US is very near the production cost, within \$5-\$10 dollars a barrel. What if we can't get any more from it, from the Chinese? Then we have all these pipelines, all of this damage done, for nothing.

Then there is a question of how much bitumen do we need to fill these pipelines? The projections that I have seen indicate, till about 2020, we don't need two pipelines. We can't fill them. A pipeline that is half-full takes the same maintenance as one that is fully full. It just doubles the cost of shipping. I know that oil company people pay a lot of attention to not overbuilding on things like that. So, again, I haven't seen enough facets of the problem, ~~is~~ even from the economic side, that I'm really happy with the economic ~~side~~ of the development, let alone the ecological ~~problem~~ ~~one~~.

I would guess if I had a preference to see us develop the oil sands at a quarter of the rate, and figure out a plan within Canada to use that oil sands to develop the secondary and tertiary industries here that the Chinese and Americans are obviously doing with our fuel. That way so that we control the whole business and we end up with a more diversified economy; not again, just existing at the whim of someone who might need our natural resources. To me that is a crazy basis for a country to live on. We have a long history of falling into that supplier of resources trap.

AD: The drawers of water, carriers of water and hewers of wood.

SCHINDLER: And, shovelers of bitumen.

AD: It's interesting that those remarks you just made resonate with Peter Lougheed's last stance on the oil sands. As the creator of AOSTRA and all the new science that was required for this era of development, the last 20 years or so, in the end, he also said, slow it down and the whole issue of Canadian ownership and Canadian control, etc., which are subtexts in what you are saying.

SCHINDLER: ~~I~~ Well, the countries that I have come to admire for their control of their environment and their treatment of people are the Scandinavian countries. Finland, for example; I did some tours back when I was on all these pulp mill ~~panel~~ things to see how Scandinavian's handled similar problems. In general, 80% of their industry has to be controlled from home. They don't like big outside investment; they don't want to lose control. I think that is a very smart move. They don't want buckets of new immigrants moving in, not because they have anything against other cultures, but because they can see that their infrastructure costs will rise rapidly, something we never seem to learn in Alberta. We hear it every day, "Our roads are all full of potholes, our schools are overcrowded and we have to wait 24 hours in emergency rooms, and on and on. Well, why?" This morning, ~~s~~ radio topic was, ~~it's~~ schools that we now have to bus kids to; ~~schools~~ because



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~~schools near their home~~ we have no room for them. It's ~~clear like that~~ people think that growth doesn't have a downside. I don't think there ~~is any~~ problem with ~~planned growth that is slow as long as it's slow~~ enough ~~to see in advance when you are threatening to exceed that you can consider whether you are exceeding your~~ you're the land's carrying capacity in terms of ~~water or~~ food and industry, ~~and so on~~. ~~At~~ ~~the~~ crazy pace that we are ~~developing~~, that simply isn't happening. If I was 20 years younger, I would probably be trying to immigrate to Norway.

AD: This has been a recurring theme in your remarks that that generation of brilliant young scientists that were studying the environment in various ways, thinking of the 70's onward, they are boomers, either at the top end or the bottom of the boomer' curve. How do you transfer that knowledge from one generation to the next?

SCHINDLER: I think, for one thing, there needs to be some stability in the system, ~~for example,~~ all the depressing things ~~are~~ going on now. I have a generation of students coming out that's really ~~adrift, with few prospects of decent jobs~~...one of my PhD students is in a deep depression. Another one is considering abandoning her thesis after five years - probably the most talented student I have ever had - just ~~because she~~ sees that what she has done is being ~~regarded as~~ of little use, that ~~they~~ ~~politicians and industries~~ will just railroad what they want to do in spite of any science to the contrary, ~~that there is no positions available to do anything that she wants to do~~. It's really a terrible time ~~psychologically to be a new scientist who is anxious to make a contribution~~.

We tend to overshoot at the other end too. In the good times everyone is running around with ten graduates students, ~~many of them of questionable ability~~. ~~and~~ ~~it's~~ like nobody, even universities, has any sense of measure. Higher growth is always considered good, ~~negative growth is bad~~. ~~It's simply not the case; maybe some growth is good but I think it has to be at a pre-measured pace, as long as you can~~ ~~We~~ ~~ust~~ ~~try~~ ~~to~~ -keep stability in the system, where talented people can see that there is going to be something for them at the end of all their ~~costs~~ ~~expensive~~ ~~and~~ ~~study~~, ~~that they are going through~~. ~~I just don't know where it is going to end~~. ~~Then, of course,~~ ~~With our unstable system,~~ what will inevitably happen we will have a whole bunch of students that will go on and do something ~~other than they are trained for~~, ~~else, including all this raw talent, and~~ ~~A few years later, we will have a shortage of talent, and we will start another wave and~~ there will be a lot of jobs available but those good people are gone, so the "not-so-good people" will be there ~~to take the jobs~~. ~~Then we start another wave~~.

AD: It has happened; when I finished my PhD in 1971, there weren't jobs in my discipline so I didn't have a career in academe but I did have a career in other areas that I think was perfectly satisfying. But, on the other hand, when you are looking at scientific disciplines that are really around the exploitation and preservation of the world's shrinking resources, it's different, isn't it?

SCHINDLER: I think it's ~~a~~ really urgent times right now. We already know we are using 50% more of the resources than the ~~planet world~~ is producing, which is why everything from diversity to greenhouse gases is really in a questionable state. ~~Yet we continue to grow in both population and consumption~~. I wouldn't be surprised if the root of all the instability that we see in economy is that



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there is no natural basis left to expand the economy, and we don't know how to operate with an economy that doesn't expands. I wouldn't be surprised if this instability that we see is permanent, and it may get a lot worse of course.

We are obviously at a point that where it takes very little of a natural catastrophe to push us over the edgetop, if you look at the effects of Katrina or the storm on the east coast, or any number of coastal disasters. It's pretty obvious that we are living pretty close to the line as a species right now. I think we need young scientific talent more than we ever did right now. ~~but,~~ That being said, I've lived through a few of these boom-bust cycles. I've always personally been of the opinion that, if it gets too unpalatable, that I can still farm and build, or something.

AD: Are there any summative remarks that you want to make about the oil sands, something that a question hasn't triggered a response?

SCHINDLER: I think if I could magically do what I thought it took to put the oil sands straight, I would say number one: we need to include Aboriginal People, in the planning² in the rate of expansion. - we need a program where we develop slowly enough and get them educated rapidly enough that they can play a part in it, and they need to get something out of the resource. Right now they aren't getting a pittance from that resource and most of the profits are going to multinationals. ~~and it's obvious that, even i~~ In the budget circumstances that we face today, ~~eventhat~~ average Albertans are getting very little of the benefit of developing the oil sands. Here we are the so-called richest province and we can't afford ~~our~~ basic services, or to fix our roads, or educate our people. Our province is deeply in debt. I mean w What kind of system we are running here, where most of the profits go to a few hands, most of them not Canadian. And I'd like to see, ~~a~~ As I said earlier, a more balanced approach to using that energy is needed.

I think we ought to be considering, ~~from a population standpoint~~, how many people we really want in this province. We know we are short of water; we know we have a lot of lifestyle reasonsthings that are why Albertans are here. ~~Today~~ Right now you can't just jump in your ATV and ride anywhere, or drive your RV and go to a National Park on the weekend and expect you are going to find a camping spot. Those went out the window about 10 years ago. Maybe it's time that we chose a level of development and of population that we don't want to exceed and stuck with that; I'd say that same thing nationally.

I think we are headed for real trouble with the current rates of population growth; the US is heading for a billion people and Canada is headed for 100 million by the end of this century. That will, given the ecological footprints that we have in this country, greatly way exceed our share of the world's resources. The US right now is using the equivalent of 1.5 United States's resources. Those resources don't exist anywhere else, so theywe are taking them fromout of countries that need them more, China and the Middle East and places like that.

We can't ~~succeed~~ ~~do it~~ strictly by cutting consumption; I think we made that experiment. I think if they are really put to the testline, you could convince Canadians and some Americans that youthey



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could live with the ecological footprint of a Finn or someone in Spain, but that is; it's not enough. So, we have some hard choices to make and I think we have to start making them. Some of them are well beyond science. Scientists can tell us what consequences the ~~We can say what the~~ choices will have, are but we can't make them choices for everyone. That's the realm of ethicists. Certainly, politicians ought to be the one that gets the conversations going because, for some of the situations, we are getting into ~~choices where,~~ there is no easy choice anymore.

AD: Well, thank you so much for agreeing to be interviewed for the project, it was fascinating stuff.

[INTERVIEW ENDED]



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