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NA2743 George Jacobson, interviewed by Pauleena MacDougall and Adam Lee Cilli

George L. Jacobson
University of Maine

ACCESSION SHEET
Maine Folklife Center

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Description: **2743 George Jacobson,** interviewed by Pauleena MacDougall and Adam Lee Cilli, July 8, 2013, in the Climate Change Institute's conference room in Sawyer Hall at the University of Maine, Orono. Jacobson talks about the beginnings of his career in botany and ecology; the environmental movement; coming to UMaine; the importance of interdisciplinarity and collaboration; obtaining funding; working with administration; the contributions of the Climate Change Institute; his own research; his retirement; petitioning the state for more research funding; his role as State Climatologist; the present and future impact of anthropogenic climate change; and the future of the CCI.

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Restrictions

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Notes

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Narrator: George Jacobson

Interviewer: Pauleena MacDougall

Transcriber: Adam Cilli

Date of interview: July 8, 2013

ABSTRACT: This interview took place in the Climate Change Institute's conference room in Sawyer Hall. The interviewer, Pauleena MacDougall, was accompanied by her research assistant, Adam Cilli, who took notes during the interview but did not ask questions. In the beginning of the interview, Jacobson discussed how he became interested in the relationship between vegetation and climate. He described his graduate studies at the University of Minnesota and his early work on lake sediments. Later, he talked about how he came to the University of Maine and about his experiences with the Quaternary Institute. In the final third of the interview, he described his own research experiences (principally his work collecting sediment cores from Lake Tulane in central Florida) and what he believed were his most significant contributions to climate science. He also shared his views on the magnitude of the global warming problem and its connection with human population growth.

Note: This is the transcriber's best effort to convert audio to text, the audio is the primary material.

MacDougall: This is Pauleena MacDougall. It's July 8, 2013, and I'm here with George Jacobson to talk about the Climate Change Institute. So, let me ask you first, what attracted you to the study of botany?

Jacobson: Well, I got interested, really, more in ecology than botany, initially. In fact, as an undergraduate at Carleton College in Minnesota, I was in a group of pretty elite biology students, almost all of whom were going to medical school. And I didn't find myself very attracted to that end of biology. And I took an ecology class, which back in 1967 when I took the class, was populated by four students; and even none of the other biology students knew what ecology was. And it was not a word in the lexicon in our country. A few biologists knew what the word ecology was; it had been invented by some ecologists early in the twentieth century. But it was not a household word at all. But I found it fascinating to try to understand the systems, biological systems, going on on the face of the earth. And so I go involved, did some research with one of my professors for a couple summers there at Carleton. That led in fact to my first ever publication, in the journal Ecology. And that was fascinating. I got drafted, went away to the Army for two years, between 1968 and 70, and then came back and I started grad school at the University of Minnesota, which had the first ever graduate program in ecology in the country. It was the first time there was one. And so I was just interested in ecology. I didn't even know plants, animals, anything. But, I went there and within about a year, I'd taken a course in plant ecology with a real good professor, who turned out later to be one of my two Ph.D. advisors. His name was Ed Cushing; and the other was Herb Wright, who was a famous geologist. But the thing that interested me was that understanding the modern landscape was obviously not enough. Most ecologists were studying the interactions of organisms, or maybe a little chemistry and things like that, but I realized in order to understand things like vegetation, for example, we didn't know anything until we knew what came before. First of all because of succession, which is shorter-term changes on the landscape after vegetation matures after a disturbance. But, even more, how things have developed as a result of changing climate as we came out of the last ice age and how recently was it different from today, and all of that. What are human influences in recent times? And it turned out that, by coincidence, Minnesota was at the time and was for a long time the leading place in the country for paleoecological research and vegetation history studies and things like that. And I just immediately became fascinated by that. The idea of understanding the time dimension of biology was really fascinating to me. And I was in a place where people were studying modern lakes, but the history of lakes, and how lakes themselves change through time by looking at diatoms and things like that. And I just got fascinated by understanding the vegetation dynamics part, and so, within a year or so, I was involved in learning how to recognize pollen grains and how to do pollen analysis of sediment cores. And that led me into my Ph.D. work, which led me here. And so, it's really a roundabout way that I ended up being a botanist. It was not because I decided plants were neat, it's just that plants were the vehicle by which I could understand the natural world and the changes. And I think plants in particular because, first of all, the plants leave such a good sedimentary record of their presence on the landscape. It's a kind of long-term chronicle of what the vegetation was in any given place in the lake sediments, and, at the same time, providing a lot of information about climate; and so, at the same time, I became fascinated by climate itself. And although I was a biologist to start with, I would say by the time I finished my Ph.D. in 1975 I learned quite a bit about climate. And eventually when I came here, and came to this Institute, I learned a lot more.

MacDougall: Well, '75 was kind of a time when there was a very strong environmental movement in the country. Do you feel like you were in any way influenced by that?

Jacobson: Well, a little bit, but Earth Day was a couple of years before that, wasn't it '72 or something like that, and so I was just starting my graduate studies in a way. I spent that summer on a glacier in the Yukon. It was a time when the world had changed. I was in college in the mid-to-late '60s, when everything changed—because of the Beatles, the Vietnam War, and all of that; everything changed. And then the environmental movement came about in the early '70s. And it was a time when we were thinking about, in very simple ways, having cleaning lakes and things like that. And the big argument in those days was whether laundry detergent should have phosphorus in them. There was a huge dispute, almost like global warming today, about whether phosphorous in laundry detergents caused lakes to get green, which they obviously did. But it was that kind of simple minded, low level question; but people were concerned about it. In Minnesota there are so many lakes. It was an important topic, but ironically climate was not a big issue. Because it happens that just during that period, in the late 50s, 60s, and early 70s, when I happened to be at college at graduate school, we were in a brief but pretty extended cold phase. Things got colder and there were discussions about the coming ice age and things like that. And so, nobody was thinking at all about global warming, greenhouse gases. The idea had existed, but it wasn't on anybody's mind in the way it is today. And we didn't think about our work as relevant. In fact, I can remember just being genuinely fascinated by understanding long-term vegetation dynamics and understanding long term climate change. And to me that was enough. That was why I was doing it; I wanted nothing more. I was just fascinated. One of the professors in another department was trying very hard to get me to become his advisee and study limnology. And I said I'm sorry, I appreciate your interest but this is what I want to do. I decided in my mind that I was going to get my Ph.D. and do this the way I wanted to and even if

I never got a job, it was going to be fun doing it. That's how I looked at it. Of course, I realized later that doing things that we're interested in is what makes us good at it. It's when we're really absorbed and fascinated by what we do every day that we do a good job. And it's not a job, it's fun. It's the reason why, five years after I officially retired, I still come to work every day and keep doing the same stuff for no money. That's exactly what it is, because it's so interesting. But the environmental movement was there, but it wasn't part of what drove me to do this. The relevance of what we're doing now, and my work as Maine State Climatologist, working on adaptation planning and so forth; it's great that we have something to offer. It's a perspective that are really surprising and unusual to people. I'm giving another big talk tomorrow night down at Boothbay. Those kinds of things are an outgrowth of what we've done. But totally unexpected, and I'm glad we have those things to offer, and I really do think we have something highly unusual to offer. Because most people have no time perspective, almost no time perspective. Even foresters, who think they do, have a hard time thinking beyond a human lifetime. And we have to be able to think in terms of hundreds of thousands of years to understand what's going on and put it in perspective. And we do that completely naturally now, because that's how we think. So our minds just work that way, but I realize in talking with ecologists and other disciplines related to ours, most ecologists are looking at modern interactions, and they cannot realize that depth of time really matters. But it's actually everything; temporal dynamics are everything.

MacDougall: So, when you came here it was not the Climate Change Institute. It was the Quaternary Institute. What drew you to the University of Maine?

Jacobson: Well, I'd spent three years working in the U.S. senate in Washington; I was initially chosen to be an AAAS Congressional Science Fellow for a year, then I spent two years heading up a Senate sub-committee staff in the Senate Committee on Environment and Public Works. And I was having an interesting time there, and I could have stayed there and kept doing that. And I always wanted to be a professor, and I still loved understanding paleoecology and long-term climate things, and it happened that Maine had formed this institute, which was called the Institute for Quaternary Studies, in 1972. And the original plan for that included ten faculty members. And there were essentially two of each, of several different disciplines, one of which was biology. And, as it turned out, I was the tenth person hired; I was the second biologist hired. And, while I was in my third year in Washington, I got a call from Herb Wright saying that he'd been contacted by someone at the Institute and that he'd suggested me as somebody who they should consider and so I should look for the job announcement. And, sure enough, I saw it in *Science* shortly afterwards and I was stunned because if I had written a job description for myself, it would have looked exactly like that, exactly. It was perfect for what I always wanted to do, and it was in a place I'd like to live, because I'm a northern person, I was dreading, maybe I'd have to go spend my career in Mississippi or something like that, and fortunately I didn't have to. So anyway, I applied for the job and ultimately got, and came here to work on April 9, 1979, which was an odd time, but I had to do some things in the Senate in that spring. So, I was drawn because I'd known even as a grad student that Maine had formed this Institute, because it was one of two that formed about the same time in the early 1970s. One here, and one at the University of Washington, in Seattle. This was a collection of people who were doing the same kind of thing we were doing in our group in Minnesota (with geologists, limnologists, biologists, and so forth) trying to understand the history of Earth systems with as many independent lines of evidence as possible, to put it all together. And so that, of course, got my interest. When I saw the name Quaternary in the name of an Institute, that was interesting. And, of course, there were some people here whose names I knew already, so that was enticing. To have a job doing exactly what I wanted and teaching not only at the Institute but in my department. Honestly, it's the best fortune I could have had was to see that add and to come here. And I've felt the same way every minute I've ever been here. It's the perfect job for me and I feel so lucky that I've been able to be a part of it.

MacDougall: When you first came, was there kind of a directive about how the Institute wanted you to focus your research, or were you pretty much able to do whatever you wanted to do?

Jacobson: I think we were all encouraged to do what we were interested in. The one thing we tried to do from the beginning was encourage people, and hire people, who were interdisciplinary. So, all of us came in with that notion that we would get engaged in one another's work. Of course, it was hard not to because it was all so interesting. And we had such a cast of characters here, how could we not be interested in each other, really? But the real crux of the matter was that we were to develop good courses and do a good job teaching, and we were to develop a real research project of our own and get it funded. That was the job. And that was the deal Hal made with University administrators in the beginning. That they would fund our base salaries and so forth, and help form this Institute, but our job was to make sure the research got funded independently—outside university funds. And that was always the deal and we've always done it, and we started small and just grew and grew and grew. Still happening. And so that was all. Of course, coming at not long after grad school, I was a little concerned about whether I'd be able to think of things to do. I was always impressed with how much my professors seemed to know; I mean, how could they think of all these projects? And I did develop my whole Ph.D. dissertation idea by myself, but that was what I did. But I realized after I got here for a few months, that just about every time I got back from coffee with someone there was another idea on the table for a possible collaborative project. The problem wasn't thinking of new ones, it was deciding which ones were valuable and could be funded. And were there the right people involved, and all those things.

MacDougall: Did you find that funding agencies such as NSF encouraged this sort of collaborative research, or was it easier to get funding for something that was more strictly focused on your own discipline?

Jacobson: Well, I think, it was a little of both. People could work in their normal environment in NSF and, if they were known by the project program directors and so forth, they could keep going. But I never found it difficult to interest NSF program directors in things that cut across disciplines. And, almost from the beginning, I think, partly, our Institute really was one of the first interdisciplinary groups, that was successful, in the country. Hal, as you know, did a lot of research on, I mean, followed up on a lot of research on interdisciplinary groups that formed in the 60s and 70s and found that most of them failed. This wasn't a novel idea, it's just that most of them were lists of people on a brochure and not really an institution. Ours was a real institution. As much as anything because Hal set it up with split salaries, and the fact that we were embedded in our own departments but still had this connection to the Institute. So, we had two real homes. And it was critical that our peer review committees were made up of people from both disciplines. All of those things really mattered. And so, we took it seriously, and I think NSF took it seriously. My experience was always that, when there was something that fell partly outside the program we were in, that program director would suggest ways to make linkages and sometimes he or she would go find another program director and figure out a way to fund that part of the project. I wasn't aware of any problems with it; I think it was just something that wasn't done very much at the time. But, I'm amused now by discussions about how we need more interdisciplinary research and how we need to get rid of silos, because we've done it for forty years, more than that. And really pretty well. And, this University didn't stop us one bit. In fact, we've had no within-university barriers to do what we do. We've been able to move seamlessly among several different colleges at the same time to get our work done, and worked well with the deans and faculties in each of the departments. Because they want successful people, too. The reviews were set up to protect both the departments and the Institute, but that was based on a fear that there might be separate interests or something. But there wasn't. Everybody always wants faculty members who are good scholars and are productive, publish lots of papers, get grants, teach good courses. That's all. And if by being part of this Institute they do that and become well-known in their field, the departments are thrilled. Cause they get to count all the grant money. We didn't. The grant money always got counted by the departments, not us.

MacDougall: I'm sure that was probably a factor in making it a positive experience for everyone.

Jacobson: It was. Of course it was. And that's why Hal and I (and actually all the directors along the way) made a real point of working with all of the department heads and the deans to make sure that everything was as seamless as possible and that we were supporting the departments and the new deans were supporting the faculty members. It was always very positive and I think by doing it proactively that way (not going asking for things, but laying the groundwork for successful collaborations) it really made for very supportive environments. I can't remember deans ever opposing something we were trying to do. If anything, it was more figuring out ways to help. 'Cause we were helping them look good, when you look at it that way. University administrators look good if people working in their institutions are successful. If colleges are more productive and get more papers published and more grants, the deans put in on their resume.

MacDougall: What do you think some of the Institute's greatest contributions have been over the years that you've been here?

Jacobson: Well, that's a tough one. Because we could actually go down the line in the different disciplines and… because we really had some wonderful scholars, and still do. Some of the original ones are still going strong. George Denton, for example, is just a towering intellect. And what he's doing today globally, there are whole disciplines of climate science that talk about George thinks this and George thinks that. And his ideas drive whole programs at NSF. And Terry Hughes, for all his challenges, was a genius of another kind who thought in very creative ways about how ice behaves. And he came up with ideas that are still driving the whole field of glaciology. A few people would argue with that, but it's really true. He thought in such an unusual way, which was part of the reason people got so aggravated with him, but he just had notions that were way different from everybody else's. And that's, of course, what we want in science. Really different ways of thinking about things, even if they're not right half of the time or even more; if they're right some of the time, but are really novel, that's a big deal. Because that then leads whole programs, and a number of Terry's ideas became whole programs in glaciology at NSF, and are still influencing the way the world thinks about it. And the work Ron Davis did on lakes and lake sediments included lots of novel things. And our archeologists have done very interesting things. Dave Sanger's whole approach to understanding what was going on with the people of the coast of Maine really is a baseline for how people understand that now. And, of course, Dan Sandweiss's work along the coast of Peru changed our understanding of the whole El Niño phenomenon. And our work on understanding vegetation dynamics and understanding the rates of change of vegetation change through time was really the earliest look at abrupt climate change. Times of especially abrupt climate change, where the whole world was changing rapidly at one time, even in very different systems. We could go on and on and on in each of these disciplines, and within each one of them. It's been, really, a fun thing watching all of these ideas emerge and the data come in. And of course now we have all the ice core work that's come along since Paul Mayeski and his crew came here in 2000. And that was while I was director that that all started to take place. So that all added another dimension of understanding very high frequency dynamics over a very long period of time in climate. So these are all things that are genuinely changing how we understand the earth's climate. And we've contributed an awful lot, even though we're still off working on our own, writing our own papers, but we're quite familiar with one another's work and influenced by one another's work a lot. That's one thing I've realized very often. I think our students who have been here a while, and who then go off to another institution, find out none of the other students no anything about quaternary disciplines. Especially archeologists, who have this whole background in understanding ice ages, vegetation changes, and all these important environmental contexts for people's living. And they take it for granted that this is how people see the world. Well, actually, they're pretty unusual grad students because they have this in their backgrounds. It's fun to hear students come back and tell us how surprised they were that they were almost unique where they ended up because they have this broader perspective.

MacDougall: Did the Washington Institute continue?

Jacobson: Yeah, they're still going. They're called the Quaternary Research Center, I believe. But it was organized quite differently. It didn't really have different disciplines, and it was largely focused on glacial geology and quaternary geology more than anything. But they didn't have the different disciplines and they didn't have a graduate program. Another thing we did that was somewhat unusual was to have our own graduate program. Initially it was a master's level program, but it was interdisciplinary in the sense that we really had students from all these different disciplines working on projects and taking classes from all these people, so it was really an unusual offering at the time. Some fine students came out of the Washington program, but they were really just classical geology, quaternary in nature.

MacDougall: So, tell me a little bit about how your own research has contributed to the Institute's goals.

Jacobson: Well, I hope it has. My early studies, even going back to my Ph.D. work in Minnesota, was focused on the species white pine and the vegetation it was living in, but when I got here I had opportunities to pursue that in a broader geographic scale and look at all of eastern North America. And it was just about that time that enough paleoecological studies had been done with radio carbon dating that it was possible to map in space and time how the vegetation changed. Margaret Davis was a prominent paleoecologist, and she did the first mapping of changing in ranges during the late glacial, but the big change came when Tom Webb at Brown University made some crude maps based on pollen abundances on the landscape through time. And I became involve in that research quite early on and was involved in publishing a paper in

1987 for the Geological Society of America. And this one was about North America since deglaciation. And I and Tom Webb and Eric Grimm were able to publish a series of maps that were quite dramatic, showing changes in vegetation since deglaciation, and at the same time Eric Grimm had written a paper just a year or two before, which by accident or happenstance we stumbled upon a way to measure the rate of vegetation change. We realized there were times when vegetation was changing rapidly, and other times quite slowly. And we did this in one site for Minnesota, but later on, for this 1987 paper, in addition to those beautiful maps that we published, we compiled information about rates of change in vegetation from sites all over eastern North America. And we were able to show that there were three or four times since the end of the last ice age when all the vegetation changed very rapidly at the same time. And that means places as different as Texas and Maine and Minnesota and Florida, were all changing rapidly, with very different vegetation. Which means there was some broader forcing, causing those adjustments in the vegetation to happen. Well, that was really important climate information. So that was identifying times of abrupt climate change in several instances. And that started a whole line of research that we pursued for a number of years, and I think that was a very significant contribution, because it's now lead to other studies of abrupt climate change that are still going on. Of course, with different kinds of ice core records and so forth, the resolution is just incredible. Another thing that happened in the early 1990s, I was involved with several colleagues in studying a lake called Lake Tulane in central Florida. And lake has, going back to the time I was a grad student at Minnesota, when we looked for lakes with old sedimentary records. And we had a hard time doing that because almost all lakes in Florida dried out sometime during the last ice age, and so we would find hiatuses or gaps in time in the sediments. But we were constantly looking for at least one lake that had a continuous long-term record. And we finally found a sediment core from Lake Tulane that had a record that turned out to be about 60,000 years long (continuous record). And we, in the process of getting this thing studied, we had the pollen diagram, and it turns out it had some big swings in the vegetation. Back and forth, back and forth, between lots of pine and not much pine, and lots of oak and grass and things like that. Alternating, obviously, between a kind of wet and dry, wet and dry. And these, each, lasted several thousand years, maybe even as much as ten thousand years during the last ice age. And that was puzzling, because we didn't know any phenomena that should have be going on in Florida that should have caused that swing in hydrology and climate. But it turned out that just at that same time there was research done on ocean cores south of Greenland that revealed there were big flushes of icebergs coming out of Hudson's Bay into the North Atlantic. And those were identified because the sediment cores from way out in the middle of the Atlantic Ocean, south of Greenland, have distinct layers of pebbles. And pebbles can only get out in the middle of the ocean if they're brought by icebergs. And they were very clearly defined in time, and after several of those cores were studied and it was realized that this was a phenomena that was quite distinct; these were dated, and it was first recognized by a German scientist named Heinrich. So these became known as Heinrich events, these big iceberg flushes that were coming out of Hudson's Bay. And this was known because the pebbles themselves were out of rocks that came out of Hudson's Bay Straights. So, it was sort of neat sleuthing. And so, this was a phenomenon that brought a lot of interest in the behavior of the Laurentide Ice Sheet, which is the one that covered us here in Maine. And, so, how did this happen? Were these warm times when the ice was flushing out or were they colder times, and there were a bunch of hypotheses and a big series of research going on by glaciologists and paleooceanographers at the time. Well, it turned out that these swings in vegetation in Florida exactly matched the Heinrich events. And nobody had any clue that the Heinrich Events had any expressions beyond just the northern North Atlantic. So, we published a paper in *Science* in 1993 that pointed out this correspondence. And that was a big deal, because Heinrich Events were really a major phenomenon, and this showed that they had an expression well beyond, way down in the sub-tropics. Something was going on related to that, which could have been causal either way; nobody knew. But the timing was right there. So, we got some new grants and gathered some new cores from Lake Tulane and really looked hard at what was going on in the vegetation in Florida during these times. We got lots more radiocarbon dates, we got lots more work on the lake itself, and it turned out, to our surprise, what we found was the icebergs that were flooding into the North Atlantic, you know, a greater version of what caused the Titanic to sink, those were the times when Florida became warm and wet. And the times in between were cold and dry. And so this was big news, and so we published a very interesting series of papers that talked about that, talked about the lakes and this relationship, and that led to a number of other papers, even up to just the last year or two, that have demonstrated that in fact cold icebergs coming out of the Arctic, which brought fresh water layer on the surface, blocked the flow of the Gulf Stream warm waters that normally go up into the Norwegian Sea, and carry the heat from the low latitudes up to the Arctic. And because this flush of icebergs that came down stopped this flow of warm water, the warm water was kept from being carried away from Florida, which made Florida warm and wet. That's why it got warm, because the heat could not be drawn away from there in the Gulf Stream current. And modeling has shown that that hypothesis was probably what it was. And so that really was a pretty important contribution to understanding the broader global phenomenon of vegetation change, but even the global behavior of the oceans, atmosphere and ice at one time. And then that, even more recently, to a project that Steve Norton and I just did. A whole 'nother interdisciplinary project. We go to coffee each day, and still do; we retired on the same day five and a half years ago, but still come in and have fun. And after all this work had gone on in the Lake Tulane core, all the radio carbon dates and all the vegetation history and understanding of the climate change, we still had lots of sediment left, cause we collected lots of cores. And so, the remainder of that core became especially valuable, because there was so much background information already about it. And we thought, you know, it would be interesting to look at the deposition of mercury in the environment going back 60,000 years. Because this was long before humans were even in North America, long before industrial pollution. What were the natural changes in mercury coming in from the atmosphere in central Florida, during a time when we know these climate shifts were going on. But how did that affect mercury? And so we got some funding for that, did some analyses (the U.S. Geological Survey down in Florida actually helped partly with this), but we did some analyses of mercury and a number of other elements in those cores which, because they were so well dated, were easy to match up. And then it turned out that there was a phenomenon that no one even knew about, about mercury deposition in soils and sediments. Because we found two times during deglaciation, when there were pulses of mercury coming into Lake Tulane that were equal to modern pollution levels. And humans were not involved at all. And it turned out that, during the last ice age, at the maximum, when sea level had been drawn down to 120 to 140 meters (because of all the water taken out of the oceans to build the ice sheets) the water table on the whole Florida peninsula had dropped. And that's why the lakes became dry, except this one deep lake that we had found. And the drying happened especially when sea water fell below about minus 50 meters, cause that's where the continental shelves become exposed. The nearest water became much further away and so there was less support for the groundwater table in

Florida. Well, during all that time, the soil around Lake Tulane was collecting small amounts of mercury. We discovered what the background levels of deposition were. They were small but consistent through time. But it turns out for about 100,000 years that small amount was falling on dry, sandy soil and accumulating there in oxide form. And it wasn't until the ground water table rose again, during deglaciation, and those soils were flooded, that the mercury was released, went into the ground water and into the lakes. Now that sounds a bit esoteric and arcane except for the fact that rising sea level today, and in the next hundred or two hundred years, is going to flood areas all over the world that have dry soils that have been accumulating lots of heavy metals, but through natural processes and after recent human pollution. And as those get flooded, these are going to be released. We actually think the big arsenic problem in Bangladesh is related to this exact thing. Anyway, we published a paper in a big time chemistry journal this last year about this whole phenomenon. It was a huge surprise to us, to find this. We thought we were just going to be documenting this low background level of mercury for 60,000 years, and that alone everybody thought was a big deal. But when we found this whole other phenomenon nobody knew about, of this accumulation of dry soils that could then be released, that was something nobody had thought about. And it was something that has global consequences. So this is the fun way that science leads us unexpectedly from one thing to the other. But that started with that Lake Tulane core that came about way back.

MacDougall: Well, I gather from the things you've talked about that you haven't really run into any major stumbling blocks or obstacles in your time here. Is there anything that you could point to that maybe was a bit of a hurdle?

Jacobson: I really have never felt any impediments. None. And I feel like my colleagues are the same. We've been able to collaborate with historians, archeologists, geologists, computer scientists. I didn't even mention Jim Fastook's modeling ice sheets; the Maine Ice Sheet Model is extremely famous. And it's used all over the world to understand how ice sheets behave and even how ice sheets on Mars behaves. It's really quite something. It really is a big deal. And it all developed when he was a Ph.D. student here, in physics, but working with our Institute. It's just another example of how we've been able to share interests and support one another across disciplines.

MacDougall: Well, what about things like state and federal support? Or university system support? Has there ever been an issue for the Institute?

Jacobson: Well, we've always wished that there would be more state support. Federal support we've had to go get. Now we've been pretty good at it. Right now, the success rate for proposals is about 10%. It's tough, and it takes a long time to write a proposal. Months to write a proposal. And it's practically a year process to start writing it and then find out whether it's funded or not. And then start again. So, it can be pretty discouraging and daunting, for sure. But our Institute averages 80% success. And so, when that's the case, we seem to know what we're doing. And I feel like the key is to have good ideas and be able to execute and be productive. And we've really done a good job, I think, of hiring people and of having students who are able to do it. And we've made a few hard decisions, but that's what it takes for any academic unit to be strong, is to be willing to sometimes say no when things aren't working. It's very painful, but for the most part we've been very careful in our hiring to try to find people who fit, not only because they're smart people who can be good scientists, but colleagues who are willing to be interacting with us and one another. I mean, we don't expect to always be collaborating with each other, but we at least like to be able to having conversations with each other easily, and be on each other's students' committees and things like that. And I think that's a big part of it. We've been supportive of one another. If we would have had stronger state support we probably could have done a little more, but on the other hand I think we've made the case to university administrators that investments in us, for a new something or other, would pay off; and we had a track record that showed we might be right. So those decisions, as I said earlier, make them look good. People like to support success, and we never went around wining about lack of support. Of course, we'd still like more, but it's up to us to do it. I've always felt that our place in the universe is up to us, really. Because no matter how bad the budget situation is for the state or how bad the economy is, if we're doing a great job of teaching and getting grants and publishing papers and working with our students, nothing can hurt us. We will be successful, and that's happened.

MacDougall: There was a time when you and some other faculty went to the legislature and were successful in getting some research funds. Could you just talk briefly about that?

Jacobson: Well, that was something not really related to the Institute, even though some Institute people were involved (Dave Smith, in particular, and Steve Norton, who is now involved). But this was back in the mid-1990s. We'd gone through severe budget problems, the economy of Maine had been bad and the state, the governors and the legislature, had been cutting our budgets. And we were losing positions like crazy. By 1996, we had lost almost 500 positions on this campus, we'd undergone nine budget cuts in five years, and some of them were done after we'd already put money aside for certain things. It was really awful, and it was a very depressing situation. Very depressing. And nobody understood that this didn't have to be. And my experience in Washington had helped me understand budget cycles and political process and so forth, and I never involved myself in that sort of thing here in the academic world. But I decided somebody better do something. So I did some thinking and got some colleagues together that became known as the "Faculty Five." Which was myself, Steve Norton, Dave Smith, Mac Hunter, and George Markovski. And I suggested to that group that we could make a case to the state and the legislature that investing in the University of Maine as a research university was critical for the state's economy. And that was the simple point to be made. Other states had done the same way back at the end of World War II, when NSF was invented to distribute competitive funding. But Maine never really made that investment to make us very competitive. And we happened to have a few small pockets of competitive science thanks to the fact that Hal did what he did and the university supported it back in the early 70s. That almost a one-time thing. Anyway, I put together an 18 month plan to change the thinking in Augusta, and gave talks all over the state and gave talks to people who were running for office, and got people from both parties to agree that this was a high priority and so, sure enough, it lead to quite a big change in funding for the university. Up till now it's actually meant 500 million coming into the university we wouldn't have had from the state.

MacDougall: And this is the MEIF fund?

Jacobson: That's a little bit of it.

MacDougall: Oh, that's only a little bit of it?

Jacobson: It's only 12 million dollars a year. The first two years, there were almost no direct research funds in the budget. And the governor at the time didn't even support it very much, but the legislature, which tried to be helpful, increased the governor's budget by two and a half percent one year and, I think, two percent the next year—the base budget for all of higher education. And those increases are still there, being compounded. And that turns out to be a lot of money. Plus, in addition to the MEIF money, which is a discrete amount of money that's there every year to support specific research, there have been related bonds that have allowed the building of research buildings all over this campus that are the basis for what's happening now. And the reason we've gone from 15 million to over a 100 million in funding in research activity.

MacDougall: And that's university wide, those figures?

Jacobson: Yes. And that was all because of this effort. And, that's hundreds of millions of dollars of buildings that we wouldn't have had. As well as this base budget support, which people don't even know about. The whole place benefits enormously from it. It led to some specific funding for research as well.

MacDougall: You're listed as the State Climatologist. What does that mean?

Jacobson: Well, it means that when I retired in 2008 my arm was twisted to do this. Maine doesn't actually have a state climatologist that gets paid or anything. I've decided I'm calling it an honorary position. It's something like being the poet laureate. It's a great honor and it gives me an opportunity to give lots of talks. And I've used it to… it led Governor Bob Bouche to ask us to do a report about Maine's future climate changes in this century. And so we published a report in 2009 called Maine's Climate Future that is sort of a starting point for adaptation plans for all of the changes that are coming. And that has led to me giving dozens and dozens of talks (I've put thousands of miles on my car; I don't get paid or anything) all over the state of Maine. Because there are people in communities, land trusts, and, I've talked to oil company boards, and, you name it. Forestry outfits. How should they be adapting to climate change, and how should they be planning? And that's what they need to be thinking about. And so I've got a talk that I think is pretty good; I vary it all the time but it gives people a long-term perspective on why things are changing and how they are likely to change. And what things they should be thinking about now. Because we make lots of decisions in society that have implications decades into the future. And climate ought to be part of those decision-making processes. So that's what I'm doing. So that's what it means. I'm communicating with people around the state of Maine and elsewhere to help them understand this larger problem, and whether it really matters or not.

MacDougall: So what kind of reception have you been getting?

Jacobson: It's really excellent. Even when I've talked to the oil company board of directors, afterwards the president of the company came to me afterwards and said he changed his opinion of climate change 180 degrees based on it. It doesn't mean they're going to quit selling oil, but they understand it. And I have a way of explaining it so that people understand it. My goal, when I give these talks, I want everyone there to understand these talks. I don't want them taking my word for anything. I want them to understand the simple, basic science. Which I can do. I've got a way of doing it, and showing them some long-term data, that are very compelling.

And, all of a sudden, they can put what's in the newspaper in a perspective. Because it's a pretty simple story, really. I've had people come up to me, every time, telling me this is the first time they understood this issue. So, it makes me feel good that I can at least help people understand the problem. I don't have any for them, but I'm trying not to give answers, either. I don't have solutions, because the policy solutions are really difficult. And they're challenges for humanity. We are all part of it, but we all have to solve it together. But it has to start at least with people understanding the problem.

MacDougall: There have some interesting things I've seen, in the New York Times or whatever, of some ideas that some people have about how to fix things. One thing I saw was some kind of pavement they're using in Belgium that soaks up CO_2, and things like that. What do you think about some of those? Do you pay attention to any of that?

Jacobson: Sure. I'm curious, because people are always coming up with engineering solutions to things. But the quantities of carbon going up into the atmosphere are so enormous. There are ways to remove it. But there really aren't ways to remove it without requiring energy to do it either, which is another problem. There are ways to remove it; there could be a scrubber-like apparatus that could remove the carbon from a smokestack, for example, and make some kind of chalky substance, some kind of carbonate substance that has to be then put somewhere. Well, where does it go? Well, that's a lot of stuff. I mean, just the amount of CO_2 we produce a year would fill Lake Huron and Lake Ontario. But that's because these trains, these half a mile trains, that come out of Wyoming filled with coal to all the power plants. And everyone one of these coal-fired power plants, which are all over the country and now all over the world, uses one or two of those trainloads a day. So every time a train goes by, think of all that stuff. What are we going to do with all that stuff that we're taking out. Sure, we can take a little bit out in pavement in Belgium or make some powdery stuff with complicated, expensive apparatus that does that, but we've already put more than half a billion tons of carbon into the atmosphere during the Industrial Revolution and since. And by 2050 it'll be at least a trillion. Over half of it has been put in in the last twenty-five years. And it's happening right now, so this is serious business.

MacDougall: So do you see any sort of natural phenomenon that might change that?

Jacobson: Well, not any good ones. Part of the problem here is that this is all about people. And one of the neat figures in our report, figure five, shows the last 5,000 years of time. And it shows human population in the top curve and then following it, a bunch of chemical signals from ice cores and so forth, and the human population before a little over a hundred years ago had never been over one billion people, and was well below that for most of it. We're at 7.2 right now. We passed 7 billion last year, and we passed 6 billion in 1999. And it's going to be 10 by 2050 and probably 11 by the end of the century, I heard that this morning. That's a lot of people, and they're all trying to live the way we do. The middle class is growing in all these countries that are trying to develop their economies, and that's only done by energy. So, China is now buying coal from Wyoming. China has now built 4 ship terminals on the Pacific Northwest coast to take Wyoming coal to China. And there are going to be trains running almost continuously across Montana to take coal to go to China. Somebody will make a lot of money doing that, but every time a train goes by it's just going up in the air. Every time. And that's what it means. So, this is not getting easier. It's getting harder. And the CO_2 curve looks exactly like the human population curve. So does the methane curve and others. And that's because it's all related to us. And this has never happened before. This is a novel experiment for Earth to have 7.2 billion people growing. And, you know, we add a Maine-worth of population to the Earth every five days. We add two Californias every year, or two Canadas, every year to the world's population. And those are all people who want to live the way we do, and who are we to tell them not to. Well, we haven't come up with very good solutions, and all the discussions about sustainability work around the edges, but never look at the fundamental question of, what is the number? To me, that is the question: what is the number? What's the sustainable number? I don't think it's ten or eleven billion. I'm pretty sure it's not. And how are we going to do this? So young people today have some challenges. We all do, but young people… Fortunately lots of smart ones will be figuring out how to solve this problem, but they better do it soon.

MacDougall: It's odd that there's so much political discourse against the idea of climate change.

Jacobson: Well, it's not intellectual discourse, though. It's economic. That's all it is. The people who are pretending this is in dispute know better. 'Cause it really is simple. The issue is that people don't want to have their source of income affected, and there are lots of people who make a lot of money because of fossil fuel. And somebody will… there are discussions about carbon taxes and so forth. And probably something like that will ultimately happen, and everybody's behavior will change pretty sharply. People will be innovating and finding… I mean, one thing I've said is that when there are ten billion people, there are going to be quite a few who are really smart. But it's going to take some fundamental change. We can't just be driving around and flying around. And we're all guilty. I mean, I know it intellectually, but I still fly off to Norway to go cross-country skiing. We can even develop having better lightbulbs and having Priuses and things like that, but it doesn't do much.

MacDougall: So it's going to take some big change.

Jacobson: It is. So the big question, then, to come back to what you said earlier, is whether there will be some natural changes that will be involved. And there could be, because the human population won't continue to grow forever. And it may be that it won't stay at ten or eleven billion. Sometimes I phrase the question differently: can all this be resolved peaceably? That is the fundamental question. Because, if there are billions of people who don't even have water, in Africa, and we have surplus water in Maine, this will affect us. I'm almost sure there will be tanker ships trying to take water from Maine to other parts of the world pretty soon. And we haven't even started thinking seriously about how we're going to deal with that. We let companies just take the water and sell it for a huge amount of money, and the state gets nothing for it. Water is more valuable than oil. At least the state should be getting rich from this, and using it to support universities and schools and things like that, but we're not. But there could be some real difficult political problems, or health, or wars, who knows. There are a lot of ways that we could get to a smaller population on Earth that wouldn't be very pleasant. And I think the challenge is to figure out a way to do it, so we can do it peaceably. People can live sustainably at some lower population level.

MacDougall: One last question for now. Do you see the Institute's mission and goals evolving into the future in any particular direction?

Jacobson: Well, it's evolved a lot. There have been several phases in our growth. That first original ten people and our focus on the Quaternary was a great thing, and it really worked well for twenty-five years or more. About the time we recruited Paul Mayewski to come and we started to do ice core work seriously was about the same time that the whole global warming issue (greenhouse gases and so forth) came to the forefront nationally and internationally. And our work became more visibly relevant in that way to people. We changed the nature of our Institute quite a lot. When I stepped down as director after Paul got here, and just a few years before I retired, we still were largely looking at the past. But when Paul came here he immediately broadened the perspective. He helped us get the name changed so that, first of all, we didn't have the odd word quaternary stuck on there that nobody could pronounce or understand or spell. But, he said, you know we all study climate change, let's put it in there because that's what we do and then people will find us. And he was exactly right. That was definitely right. But he quickly expanded the scope of what we do to include a lot of things related to modern systems. And so we have ecologists, and scientists, and political scientists, and all kinds of people who are looking at what's happening to the world today, with the consequences of climate change on human populations. So now we have dozens of people from around campus and colleagues from elsewhere who are attached. So it's really quite a major change in who we are. And so we can no long sit around this table, literally, as a faculty and talk about things every couple of weeks, the way we used to do for years. And it has changed who we are, and it's made it more difficult in some ways to have a cohesive whole. Because it takes a lot more work to interact with that many more people regularly. And so it doesn't happen, really can't happen, as much as we used to do. We have our annual Borns Symposium in the spring. That's a great way of connecting with each other. We still have a fall field trip of some kind, and that gets us together. But the challenges of interacting across campus are greater than they've ever been. In fact, at the Borns Symposium this year I made a plea to everybody to think very hard about how to do this and to continue to make that effort. Because it's very easy to be so busy that we don't have time to go to a seminar in some other related discipline. And we all are busy, and we travel, so it takes a special effort to be part of this great Institution. And I hope we can keep doing it.