

John Boccacino:

Hello and welcome back to the 'Cuse Conversations Podcast. I'm John Boccacino, senior internal communications specialist at Syracuse University.

Charley Driscoll:

We've seen that with improvements in air quality. We've seen recovery from acid rain and other air pollutants. It was really a great opportunity for me to see that we can really impact things at a very large scale, and also that ecosystems can be quite resilient and can come back from rather significant disturbances. Today, the air quality is much better than it was back in the seventies and eighties. It's remarkable the changes that we've seen and we're starting to see recovery. Certainly the lakes and fisheries are coming back. It's a remarkable success story.

John Boccacino:

Our guest on this episode of the 'Cuse Conversations Podcast, he is Charley Driscoll, a civil and environmental engineering professor in the College of Engineering and Computer Science. Now, Driscoll is one of our nation's leading experts on pollution research, and he's also played an instrumental role devising strategies to reverse the damaging effects of acid rain and mercury contamination in our lakes, as well as pollution studies across the country for air pollution and environmental damage caused by those pollutants. Charley, I know you're busy this time of year. Thanks for making the time to join us.

Charley Driscoll:

I'm happy to come on. It sounds like we'll have an interesting conversation, I'm looking forward to it.

John Boccacino:

Give our audience a little background on yourself and your role with the university.

Charley Driscoll:

I'm a professor in the Department of Civil and Environmental Engineering in the College of Engineering. I do interact quite a bit with other programs across the university. I've been at the university for 45 years, I have a lot of experience with the university. I'm actually from the central New York area, I've lived here virtually my entire life. I teach a class in biology in biochemistry, which is large scale element cycling. I also teach an undergraduate class to help prep our senior civil and environmental engineering students for their professional licensing exam. Those are the two major courses I teach. I do sporadically teach a few other courses including a course in climate change, and I do research on different environmental issues pertaining to air pollution, water pollution, like you mentioned, and I try to do a lot of outreach. I'm on a number of boards, local boards and national boards, national committees. I try to do as much outreach as possible in terms of talking about different types of environmental problems and how I can help out.

John Boccacino:

And what led you down this path of wanting to work in assessing and quantifying those responses of our ecosystems to those various environmental disturbances that you were discussing earlier?

Charley Driscoll:

It's interesting. When I was a kid, I liked the outdoors. I camped a lot, was in Boy Scouts. And when I was in high school I really liked chemistry and I wanted to have an engineering track. Eventually I went to the University of Maine and I majored in civil engineering, but I had a particular interest in a

component of civil engineering, which is in environmental engineering. I decided to go on for graduate work, which I did at Cornell, my master's and PhD.

And in particular, I took a lot of natural science classes in addition to engineering classes. At the time, most engineers of my ilk were focused on water treatment processes and solid waste processes and things like that. But I was particularly interested in larger scale effects of pollutants on the natural environment. My dissertation work was actually on acid rain impacts in the Adirondacks, the chemical effects and effects on fish, and that was my early work at Syracuse, my early research. In addition, I also worked on Onondaga Lake, which I've been continuing on for my time. And then the work on acid rain led me to other air pollution issues like mercury. I also do quite a bit of work on climate change and as you mentioned, I do quite a bit of work on ecosystem restoration. Onondaga Lake, I've also been working in the Everglades for 20 plus years and other ecosystem restoration projects.

John Boccacino:

These are issues that really touch on every person in this country, regardless of where you live you're going to deal with some air pollution, you're going to deal with pollutants in your water. How would you describe the magnitude and the importance that your research plays?

Charley Driscoll:

It's interesting. The acid rain problem, which was really the first problem I worked on, originated from largely coal combustion, largely in the Midwestern part of the country. It also has a transportation source for automobile emissions. And when I started this work, which is in the seventies, it was just really at a point in the country was becoming concerned about air pollution, air pollution effects mostly from a human health standpoint.

And there was relatively little analysis discussion on those impacts on lakes and soils and vegetation and wildlife and things like that. It was of interest to me because I spent a lot of time in the Adirondacks. I love the Adirondacks, it's a great area and it was an interesting problem, and a pretty large scale problem. We're talking about air pollution from the Midwest impacting hundreds of miles downwind, and a lot of people didn't believe it was possible and were skeptical at the time, but we've seen that with improvements in air quality, we've seen recovery from acid rain and other air pollutants. It was really a great opportunity for me to see that we can really impact things at a very large scale and also that ecosystems can be quite resilient and can come back from rather significant disturbances. And that has led me to other problems like we talked about the mercury problem and also climate change. We're doing a tremendous amount of work on climate change and that's a much bigger problem, more wide scale. It's a global problem. It's really informed the direction of my work.

John Boccacino:

And when it comes to, I want to start off because you mentioned acid rain being the first problem that you really dealt with amongst the pollutants. Peel back the curtain for us a little bit. How does a researcher go about tackling and studying this problem? And then what have been some of the trends that you've seen, before we get to restoration, what are some of the trends we've seen about acid rain and the impact that it's had?

Charley Driscoll:

It's interesting. When I first worked at Cornell, I got involved with a fellow in natural resources who was quite interested in the impacts of acid rain on fisheries. And they didn't really understand the mechanism. They thought it was because the acidity was high and I was quite interested in environmental chemistry. And I'd read a little bit about some of the problems and I knew that there were reports of aluminum toxicity. It's more speculation than anything else. And I decided to collect samples in the lakes in the

Adirondacks and streams and look at the acid-based chemistry, but particularly focus on the aluminum. And I teamed with one of his graduate students and she worked with me and did fishery surveys up in the Adirondacks. And my data were informing the presence and absence of fish and the sensitivity of different fish species. But I also worked with her because she did laboratory experiments to look at the mechanisms by which aluminum could be toxic. And it worked out amazingly well. We found indeed aluminum was a big driver.

What happens is aluminum comes from soil and the aluminum normally stays in the soil, but in the presence of acids, it becomes dissolved and gets into lakes and streams and it's highly toxic to fish. And it is generally thought that that is the main driver of fish response. And also we learned later tree and vegetation response to acid rain because of the toxicity associated with aluminum. I was in the right place at the right time, and there was a meeting, some of it, one of my professors at Cornell had a workshop on acid rain in the mid 1970s that I was invited to. I was the only graduate student there. And I gave a talk on my work and I met some spectacular scientists, people who were world-famous, they liked my work and I interacted with them. That really stepped me on the path.

And then I came to Syracuse and I continued to work and it has evolved. We moved from lakes to the soils because that's where a lot of the problems originate and then effects on trees and effects on other components of the ecosystem. What seemed to be a relatively constrained problem back in the day, eventually through the eighties and nineties, developed into a more widespread problem with certain species of trees heavily impacted by air pollution such as sugar maple and red spruce being really devastated by acid rain impacts. And what we saw at the end of the Reagan administration, at the start of the George HW Bush administration was there was a big effort to try to control that, and there was an acid rain component of the Clean Air Act and controls started to be implemented, which continue today. Today the air quality is much better than it was back in the seventies and eighties. It's remarkable the changes that we've seen, and we're starting to see recovery particularly in the lakes, less so in the soils, but certainly the lakes and fisheries are coming back. It's a remarkable success story.

John Boccacino:

How do you use models as both a research tool to understand the effects of these disturbances and also a management tool to lead to remediation down the road?

Charley Driscoll:

I'm an engineer. I like math and models, but I'm also an experimentalist and I really pride myself in being a field experimentalist. And I think those two aspects of the discipline go hand in hand. If you develop a model, you have a mathematical description of the processes and phenomena that you are observing. We were interested in developing a model that we could use as a tool to validate our understanding of the phenomena of air pollution on ecosystems, but also make projections on how the systems might recover under different emission control strategies. I learned a lot from interactions with my biological colleagues and soil scientists that I've worked with and studied under, and we wanted to depict those processes in the models that we developed. I partnered with people who were working on models, this is back in the nineties, and we expanded them to include the detailed chemical processes and phenomena that we've been observing, and we've gotten a lot of mileage out of this. We've applied these models to the Adirondacks. We've done a lot of work in national parks, particularly the Smoky Mountain National Park, which is impacted.

In fact, we have a new project that's just getting started. We did a lot of work maybe 10 years ago making projections of how the park might recover from decreases in an acid rain. And they just contacted me. They just wanted us to go back and use our model to see how well it actually did because the emissions had decreased. But not only that, but look at the interactions between the air pollution and climate change and how climate change will either delay recovery or maybe accelerate recovery. It's an unknown factor. It alters temperature and precipitation, and we have those processes built into these models. The model

that we originally developed, we're using it for all sorts of applications now, for a variety of questions, many of them climate related or looking at the interaction between air pollution and climate change and how those two broad types of disturbances are interconnected. And it's been a very useful tool.

John Boccacino:

And what would you say are some of the successes that we've had in remediation from these disturbances caused by pollution and where is there still great room to grow, like you mentioned soil remediation during our previous conversation?

Charley Driscoll:

Remediation is a real challenge for something like acid rain. We've done remediation in Onondaga Lake, and that's been wildly successful because it's a relatively local problem. But acid rain affects high elevation areas all through the Eastern US. You're talking all along the Appalachian mountains. From Georgia up to Maine, those soils and waters have been heavily impacted by acid rain. We have done experiments where we've added chemicals, base chemicals like limestone, which is commonly used in gardens to neutralize acidity. We've applied it and then we've looked at the response of the system.

And we know that from those experiments, that if we restore the bases like calcium and magnesium and soil that are needed by plants and microbes and decrease aluminum, that we can recover the systems. Sugar maple, that was doing very poorly. If we apply chemicals that neutralize the acidity, it will recover and grow like gangbusters. It's completely reversible. But the trouble is that the footprint of acid rain is massive, and it's very difficult to do that on any meaningful scale. That's why we've learned that emission reductions, it's really informed that we have to focus on emission reductions to recover these systems and soils. Lakes recover relatively quickly, but soils are developed over tens of thousands of years. They are highly sensitive and they recover relatively slowly on the order of decades to centuries to recover. It's going to be a long-term recovery. They're getting better, but it's a slow process.

John Boccacino:

One of the success stories we can highlight is your work analyzing the impact of pollution on a place close by to campus, Onondaga Lake. Give our audience a little insight into the study itself, what was done, and then how we've been able to clean up a lake that had a reputation as being one of the most polluted in the country as of 10, 15, 20 years ago.

Charley Driscoll:

This is another example of me being lucky and in the right place at the right time. When I was hired at Syracuse in the late seventies, the fellow I replaced, he was very interested in Onondaga Lake and he had graduate students. I actually inherited some of his graduate students and they were working on Onondaga Lake. I got dragged along. And we did work over a number of years characterizing the pollution. And the pollution actually comes from two major sources.

One was the domestic wastewater coming into the lake and the other was from industrial pollution. And there was a lot of discussion, a lot of resistance to cleaning up Onondaga Lake. As you say, it had a bad reputation back in the day, very, very highly polluted, did not meet water quality standards, but there was a local non-government organization sued the county over violations of the Clean Air Act, and the county was forced to clean up their domestic waste, which they did thanks to former Congressman Jim Walsh.

And first of all, the domestic waste was cleaned up. And then the industrial waste, there was an agreement about that with the chemical company that had gone out of business. And we had just made some discoveries associated with the implementation of the cleanup of the domestic waste, which we thought would benefit the industrial contamination. And we went to talk to the company and they said, "No, we've had agreement with the state. We're on track. We're going to go in another direction." And I mentioned

this to Congressman Walsh, he said, "I'll make a few phone calls," which he did. Soon after that, we were talking with the chemical company about implementing our idea to help facilitate the cleanup. And eventually they implemented this. And I have to say Onondaga Lake, it has had a bad reputation, but is one of the remarkable success stories in this country of a lake cleanup. It meets virtually all water quality standards now.

John Boccacino:

It's great to hear that success story out there. And I want to spin this. We talk about the public health benefits. There's something that you're pretty highly involved with decarbonization policies. How can you explain your work with decarbonization policies and how that has health benefits that again, really impact people everywhere?

Charley Driscoll:

People don't realize that there's a close connection between air quality and climate change. But when you think about it, a lot of climate change is driven by fossil fuel combustion, particularly coal, but also natural gas, gasoline. And when we burn fossil fuels, we emit air pollutants. And if we stop burning those fossil fuels, there will be tremendous air quality benefits such that the health benefits associated with improving air quality will save way more money than the costs to decarbonize. Now, decarbonizing is going to be a tremendously challenging operation. We've been turning the corner for the first time and we're seeing the benefits of that. We're seeing a lot of renewables being used for energy such as solar and wind power, and these have their downside, but I think they're a better alternative than fossil fuels.

And we're also seeing a lot of low emission vehicles and electric vehicles, which also help in this regard. We're starting to move in that direction. But the air quality benefits that we will see, will save hundreds of thousands of lives, reduced asthma attacks or cardiovascular disease, respiratory diseases, all these chronic ailments, many of them are linked to poor air quality.

John Boccacino:

I want to give you a little kudos in your role of being really considered one of the country's foremost pollution experts. You've testified before congressional bodies, you've shared your expertise. What are some of the ways that you've been able to lend your expertise as someone who can help impact and change some of the pollutant tendencies that we're dealing with?

Charley Driscoll:

I've been fortunate. I've been on a lot of national committees dealing with air pollution, water pollution. I have had the opportunity to testify in Congress a number of times about different aspects of air pollution, water pollution. I've gotten a lot of experience. I'm also asked in a lot of public lectures. I think over time I've gotten better at it and I enjoy doing it. And the other thing is, it's interesting because sometimes you'll get questions back from people, people who are not very technical or expert, but they will come back and give you some questions on their perspective that they don't understand or that they view things from a somewhat different angle than you've been thinking about. And I find that to be a great benefit because it really gives you a broader perspective on the problem and how people view it.

And that's really influenced my science as well. I view this as a feedback loop, having this interaction, they may have questions that I haven't really thought about that are pretty compelling questions that are

worthy of consideration. And that has certainly influenced my research direction over time. There's not just a give back. I get a lot out of those interactions from these various groups, including the general public. I welcome those opportunities.

John Boccacino:

And when it comes to opportunities, I want to give a little moment to spotlight our students, your role working with students in the classroom, in the lab, and maybe how they push you and you inspire them to be the next members who are going to take on this important challenge.

Charley Driscoll:

I've been at the university for 45 years. I really enjoy interacting with students. I have greatly benefited from student work. I try to give students their own project, and depending on where they are in their educational journey, some of them are fairly basic and some of them are fairly sophisticated, and you want them to really get something out of it. But I've had amazing students that have just gone on and done remarkable things. And often it starts at a very young age. I have faculty whose kids are interested in environmental problems, ask me if they can come in and work in my lab over summers or during school vacations. And some of them have done projects, done science fairs, and then they've gone on to college and graduate school, and now they're in positions, significant positions dealing with environmental problems in industry or in government or in NGOs. It's really remarkable. I really enjoy this and I really enjoy interacting with students.

John Boccacino:

And you mentioned the Driscoll Laboratory. I want to do a little two-parter, both highlighting the Driscoll Lab and also the Center for Environmental Systems Engineering here on campus. Describe a little bit about the impact of the lab.

Charley Driscoll:

The lab is in Link Hall. It's now on the fourth floor, but we're in the process of renovating the building. It's going to move to the third floor of Link. And I have a lab manager who's been with me, Mario has been with me for 20 plus years, 25 years. And he basically runs the operation. We have a lot of equipment. We have a lot of students that are in the lab. We have faculty who work in the lab. We have graduate students, we have postdocs, we have undergraduates, we have high school students within the lab, and people come in, the equipment's there, it's there to be used.

And we want the community to use the lab, and we want students and faculty to get as much out of it as possible. It's a resource on campus, it's an open system. We have a lot of students from ESF, from other departments on campus, earth and environmental science, biology, chemistry, chemical engineering. They come in and use our facilities, and that's what we like. We like the equipment to be used. We like students to do projects and learn. And it's a great operation.

John Boccacino:

And then secondly, how has the Center for Environmental Systems Engineering really helped to advance your work?

Charley Driscoll:

We have equipment. As I said, we want the equipment to be used. We have students that have a problem and they don't have the facilities to deal with it. They come in and work and do some analysis, and sometimes they drag me into their projects and I learn from them. And we take people from Cornell,

people from Clarkson, people from Buffalo, people from Albany come in and use the facilities, students and faculty. And that generates interaction with the students here at Syracuse and either the students or faculty from these other places. And sometimes there's some things that click and they have interactions and go off and do things together. It's a great clearinghouse for environmental activities and environmental discussions. And I've been very fortunate that the university and the college and the department have been very supportive of my operation. And I think it's been a benefit not only to the Syracuse community, but I think the broader community as well.

John Boccacino:

Charley, before we close off our conversation, I want to have a full circle moment with you because you mentioned earlier doing a survey of lakes in the Adirondacks in the 1980s studying acid rain and their impact. You've got an exciting update for us about going back in the summer. Tell us about what you'll be doing to go back and look at the impact that has happened from pollution and the results of acid rain on those lakes in the Adirondacks.

Charley Driscoll:

As you mentioned in the eighties when people were skeptical about acid rain and its impact, the state of New York, who was one of the states most highly impacted, decided to do a big survey of lakes in the Adirondacks. And there's approximately 5,000 lakes in the Adirondacks. And we surveyed about 1500 of those lakes over a four-year period in the mid-eighties to try to characterize the nature of the problem and how many lakes were impacted and what was the degree of the impacts and how it was affecting fisheries and other biological resources. And that was a highly successful project.

It really informed the acid rain problem and really drove actions to reduce emissions, as we've talked about. Now there's a lot of interest in to what extent those lakes have improved, but also what are the impacts of climate change. Together with partners from RPI, Cornell, the Ausable Center for Freshwater, the New York State Department of Environmental Conservation, and hopefully other people, we're going to embark on a survey starting this summer where we're going to look at a large number of lakes and address a number of environmental questions, prominently climate change, but also how they're recovering from acid rain and mercury pollution and other emerging problems, such as the degree to which they're impacted by harmful algal blooms, which is a problem which is emerging across lakes through the Northeast and the entire country. It's very exciting to continue this work and work with partners that will carry this on and hopefully engage a larger community in the nature of the resources.

John Boccacino:

You've definitely made an impact on our campus. You've made an impact through your work with our students, and of course, as being one of the country's leading experts on pollution research, he is Charley Driscoll, a civil and environmental engineering professor here at Syracuse University in the College of Engineering and Computer Science. Charley, thanks for making the time. Keep up the great work, and again, I really appreciate your insights today.

Charley Driscoll:

Great. Thanks John, and enjoyed the conversation.

John Boccacino:

Thanks for checking out the latest installment of the 'Cuse Conversations Podcast. My name is John Boccacino, signing off for the 'Cuse Conversations Podcast.