the weekly anthropocene

dispatches from the wild, weird world of humanity and its biosphere

By Sam Matey

Scientist Spotlight #2: An Exclusive Interview with Dr. Lucille Benedict

Dr. Lucille Benedict (pictured) is an analytical chemist working at the University of Southern Maine. She runs USM's Quality Control Collaboratory (QC2) Lab and teaches an array of chemistry classes. Her areas of expertise include environmental chemistry and industrial quality control for breweries.

A lightly edited transcript of this exclusive interview follows. This writer's questions and remarks are in **bold**, Dr. Benedict's responses are in regular type. **Bold italics** are clarifications and extra information added after the interview.

Hi Dr. Benedict! There are so many things I want to talk to you about! Let's start chronologically, if you will-why did you become an analytical chemist? Basically, my focus in undergrad was to try to save the world. I was very focused on environmental contamination and how that can be tracked and remediated. I got really invested in the question of how do you find out how much contamination is in that spot, and that's really all analytical chemistry. So I was advised to do a chem major, as that gives me the tools to work with that.

That's awesome. So you've worked on a lot of really interesting environmental chemistry research projects. I'd like to start with your Ph.D. thesis project, if I may, where you looked at the presence of the toxic PCB and PBDE compounds in the Hudson River. (*PCBs are a family of 209 synthetic chemicals formerly used in a variety of industrial applications. After researchers found that they caused cancer, they were banned by the US in 1979 and the United Nations Stockholm Convention in 2001. However, they are still a pollutant of concern, and are still present in nearly all humans' bodies. For more, see goo.gl/Tqkf8u. PBDEs are chemicals currently used as flame retardants that are*

***considered potential health risks. Some PBDEs are currently banned in California and the European Union*). Could you tell me more about that project and its implications?**

Sure! So we looked at polychlorinated biphenyls (PCBs) and polybrominated diphenyl ethers (PBDEs). PCBs are a historic compound, so that's a really interesting project because what we were looking for was twofold. We would take sediment cores and use dating techniques to section out the cores by date. Usually we'd go down to, say, the 50s in dating. So we'd look at sections of that core and we'd create time trends of PCBs in the Hudson. You could see that there was a dam removal, and that led to a higher concentration of PCBs coming down the river. And then over time you'd see a decrease in concentration, as the highest concentrations were buried with the sediment. This was used to look at what needed to happen in the Hudson, what areas were being buried and where remediation was necessary. Also we were looking at floodplains, because there were areas of the banks that were getting flooded and getting stuff deposited there. We looked at whether those were laden with PCBs and whether that was a danger.

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And were they? What were the floodplain sedimentation PCB levels like? Some had very high levels of PCBs, some didn't. It was dependent on the area, and whether the river was being scoured and redeposited. So, we worked on that, and then alongside that the PBDEs, which were a new compound at the time-they're flame retardants. So we started looking at the time trends of those, and that was a different story, because you just saw the increase in the sediments, although definitely at much lower concentrations than PCBs. Those were coming in from wastewater, not from an event that happened, like PCBs. We looked at those near New York City, and one of the interesting things we found was that you could tell where they were coming from based on the kind of mixture you got. A lot of it was from

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wastewater, but another interesting, and sad, signal that we saw in the Hudson River was from when the World Trade Center went down. There was a sampling site not far from there that was sampled after the dust and debris was deposited, and we could see a very high signal for PBDEs from that destruction. Because we're talking about office buildings, which are laden with PBDEs.

Wow. I was actually just about to ask about that-you essentially found the fingerprint of the World Trade Center attacks in the sediments of New York Harbor, right? In what was it, 2005? Was that intentional, or did you just go "wow, this is evidently due to this?" It was just with that one sample site, and we just happened to come across that.

One project you worked on that I found absolutely amazing was the one-I believe this actually produced several papers- where you were on a team that was looking at sperm whale tissue samples as an indicator of global strontium, mercury, chromium, and other heavy metal pollution. Could you tell me more about that? That sounds so amazing!

While I'm on the paper, and I definitely did a lot of work for the group to help connect the levels they were getting to preexisting data, I didn't do the analytical research there. I can't speak to how they got the samples and things, but it's a really cool project. **How did you determine the relationship between the metals in this tissue samples and the metals in the rest of the world?** We were comparing data from previously reported articles to what we found in the whales. So we were looking at other species around the world, asking how do our levels compare to those in other marine ecosystems. **Awesome.**

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In the current session of your Analytical Chemistry class, you've integrated a fascinating citizen science design instrumentation project into the coursework. Could you tell our readers more about this? Um, actually I can't. **Okay.** We're going to talk about that in class on Tuesday, but because we're developing something that's potentially commercially viable, we need to keep it on the down-low. **Oh, okay, I'm sorry. Do you want me to just scrub this section from the interview?**

No, we can talk about the ideas around it. **Yeah, tell me why you wanted to integrate a citizen science project into the class.** There's two reasons why I chose the project that we're doing. One is that we'll be able to create devices that are

easily accessible and low-cost, and I think it's really important to be able to create tools that are usable by people without an incredibly strong science background. There should be tools out there that are easy to use, but they're often cost-prohibitive and sometimes not user-friendly. That's something I want to tackle. **You want to democratize this aspect of science.** Yeah, exactly. We'll start with a smartphone, which is a piece of technology everybody knows how to use. And the other piece of it, the educational part, is that in science classes we do not typically get to go down the road of invention. This project allows us to be using our critical thinking skills to be innovative and to try things where there's no right answer. That's not generally the type of experience you get, but it's the kind of learning experience that gives you more than if you'd followed a cookbook lab.

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So, what else would you like to share? I've asked questions based on what I've read about your research, but I might have missed something. What do you feel that citizens should know about analytical chemistry? Oh boy, what do I want to share about my work...I guess two things. One is that good analytical data is incredibly important. We see a lot of things on the news right now about science and what is valid and invalid research. With good analytical chemistry, the data is verified, and knowing that is really important. That's part of the analytical process. The other thing that I think everyone should know is that chemistry is not that hard. It can be accessible to everybody, and it's a really important subject for citizens to know to be able to make educated decisions about our world. Especially as our world and climate are changing. Yeah, those would be the two things.

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Well, Dr. Benedict, thank you so much for your time and sharing your wisdom. Thank you so much for joining this interview. It's been a pleasure talking with you. Oh, you're welcome!