Q&A with Nathan Myhrvold

Interviewed by Susan Straight

Nathan Myhrvold, Microsoft Corporation's first chief technology officer, is an inventor, an entrepreneur, a mathematician, a scientist, and a chef. According to the *New Yorker,* Bill Gates once said, "I don't know anyone I would say is smarter than Nathan." Myhrvold holds two master's degrees (in mathematical economics as well as geophysics and space physics) and a Ph.D. in theoretical and mathematical physics. He has published original research in peer-reviewed journals in paleobiology, astronomy, and climate science, and he won the James Beard Foundation Award for "cookbook of the year" for *Modernist Cuisine: The Art and Science of Cooking.* He is currently working with other scientists on geoengineering solutions to reverse the effects of climate change.

What's the most pressing technology challenge facing humans today?
It's an interesting question, there's no single answer to it. Medical science is something that will ultimately fail all of us. And many of the things that would have failed us 50 or 100 years ago are essentially solved now. We can look forward to that improving. We'll probably never live forever and certainly that is a pressing problem that everyone faces at some point.

But more broadly across society, I think our age will be known for a time when we had to change our energy infrastructure. We had to go from a fossil fuel–based world to a carbon-free–based energy system. And that is very difficult. There are a lot of technical problems to be solved.

Tell us about your work to design geoengineering solutions to reverse climate change.
At the moment there's lots of talk about the dangers of climate change but it keeps happening. Every year, there's more CO_2 when they measure it at the top of Mauna Loa and we have not had a year where it goes down. It turns out, because of the nature of CO_2 and how long it lasts in the atmosphere, once we finally do get our act together and start decreasing our annual emissions, the CO_2 that's there will still stay there for thousands of years. As a result, I'm pretty pessimistic that we will be able to contain global warming just by switching to a carbon-free energy infrastructure. It's an important thing of course, but by the time we do that switch, we'll already have a lot of climate change.

So is there anything that can be done? And the answer, surprisingly, is yes, there is. Geoengineering is a set of techniques that use science and technology to reduce or ameliorate or make [tolerable] whatever global warming effects there are. And the ideal is to reverse global warming directly.

So the reason geoengineering is possible is that climate change is really a very small effect. Sunlight comes from the sun, strikes the earth's surface, and bounces back into space. And because there's extra CO_2 in the atmosphere, more than there was 100 years ago or 1,000

years ago, that extra CO_2 captures some energy. But the way the math works, it only captures about 1% extra. So the sun deposits about 300 watts per square meter if you average over the surface of the earth and average over the year. The total heat of the extra amount that's being captured is currently two watts per square meter or less, by just about everyone's estimate. It may go up and double—up to three or four watts—but it's still only 1%. So geoengineering is a set of techniques where you make Earth reflect just a little bit—1% more reflectivity—into space, and you cancel out the effect.

People have looked at a variety of ways of doing this. The simplest I've worked on is by injecting particles into the stratosphere. We know that when a large volcano goes off, like the eruption of Mount Pinatubo in 1991, the particles that go up into the stratosphere will circle the earth for about a year to 18 months. But during that year to 18 months, they will reflect enough extra light that it will subtract the current effect of global warming. In fact, Mount Pinatubo caused about a year-long decrease of almost one degree centigrade, which is about the amount of global warming we currently have. We can't count on Mount Pinatubo going off every year, but there are ways we can put those particles up into the stratosphere.

Other people have looked at brightening clouds over the ocean. The clouds over the ocean have a problem—they need dust in order for the droplets of water that make up the cloud to have something to nucleate on. If you add just a small amount of dust, the clouds get brighter. Now remember, we only need it to be 1% brighter and 1% brighter is not really visible to human eyes. We don't really see gradations of flux that's that low, so [we just need] a tiny amount of extra particles put over the ocean. And the simplest particle to put over the ocean is just to spray sea water up. The sea water will evaporate, which puts a fine dust of salt particles, which of course fall right back in the ocean.

People are looking at all kinds of other methods, including painting all of our roads white and painting all of our roofs white. Each of these is a way of trying to manage the radiation budget of Earth so we can cancel out the effects of that extra CO_2.

You designed the touring exhibition on food photography for science museums in collaboration with Seattle's Pacific Science Center. You also created the Modernist Cuisine Galleries (modernistcuisinegallery.com), commercial galleries that sell limited editions of your photographic works. Given your ongoing career in technology, why did you want to pursue what some might have made hobbies—cooking and photography—as professional pursuits?

Because I love doing them. I love technology and I have a career in it and I was always interested in science and learning. But I was always interested, since I was a small child, in cooking and photography. Initially my interest was purely driven by my own curiosity, but then I started writing big cookbooks and taking pictures to illustrate those cookbooks, and then people asked us if we could display them, so we did the show at the Pacific Science Center. Food is a great way of introducing people to experimental science. I like to say that cooking is the only science experiment that we all do on a regular basis. And you know it's an experiment because

people say, “Well, I hope it turns out.” And of course, when you cook, you are doing an experiment in chemistry and physics. The photographs I took help illustrate both the science of food and some of the hidden aspects of food you might not see with your naked eye (we used microscopes and other techniques). And then people asked if they could buy them. Initially it was like, you’re kidding, right? But no, they actually wanted to buy them, so we opened the gallery.

You funded the creation of and exhibition on the working model of Charles Babbage’s Difference Engine (an early analog computer). What are some things you learned in working with science museums?

It’s fun for me to work with science museums as an adult because I loved them as a child. In the case of the Babbage Engine, Charles Babbage had designed a computer that was implemented not with semiconductors the way our computers are implemented today but with brass gears. And that was in the 1840s. He never got one built during his lifetime. There was a big debate: were Babbage’s ideas way ahead of their time and doomed never to be made there—or could you actually have built it? The Science Museum in London discovered that they had the plans and conceived this notion that they would try to experimentally verify whether it was buildable by building it. And just like Babbage had, they ran out of money. I met up with them and thought it was a really great thing to support, so I did.

Science museums play a really important role in our lives because science and technology [are] necessary to almost everyone now. When I was a kid, the impact of science and technology, although considerable if you look back decades previous, was nothing like today when kids grow up working with tablet computers from the time they’re two years old. And a science museum is a great way of getting kids interested in science and getting them to understand their world and showing them that they can understand their world in ways they just couldn’t have imagined on their own.

What’s your favorite science center?

It’s hard to have a single favorite. Of course, I like the Pacific Science Center here in Seattle and I’ve done a bunch of work with them. For historical collections, it’s pretty hard to beat the Science Museum in London. England had a front row seat at the development of science and technology starting in the 1600s onward, so for historical collections, it’s pretty hard to beat. From a hands-on, do-experiments point of view, it’s pretty hard to beat the Exploratorium in San Francisco, which played a huge role in originating that type of science museum where you actually could do science experiments on really simple things—but sometimes quite complicated things. Those would probably be my two favorites in the world. But wherever I am, I try to go to the local science museum.

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