Alex Trembath: Hello, thanks for tuning into Breakthrough Dialogues, the podcast for pragmatists and problem solvers, brought to you by the Breakthrough Institute. I'm Alex Trembath, Communications Director at Breakthrough.

Emma Brush: I'm Emma Brush, Managing Editor of the Breakthrough Journal.

Alex Trembath: At Breakthrough Dialogues, we sit down with some of the world's leading thinkers, to talk about modern and technological solutions to environmental problems. Listen regularly and you'll learn about energy and climate change, conservation and human development, food and farming, urbanization and industrialization, and more.

Emma Brush: If you like our show, you can subscribe to Breakthrough Dialogues on Apple Podcasts, Spotify, Stitcher, Google Play, Overcast, or whatever your favorite app is. A quick note about this podcast, for our inaugural episode: the Breakthrough Institute is a global research center that identifies and promotes technological solutions to environmental and human development challenges. This podcast is part of a larger commitment at Breakthrough, to extend the conversations we host within our own circle to a broader audience, in an attempt to move beyond the tribalism and polarization that too often characterizes environmental thought and politics today. Our hope is that by conversing with some of the leading thinkers on the topics of food, energy, conservation and climate -- like-minded or not -- we might begin to move these discourses in a more genuinely pragmatic and inclusive direction, geared toward confronting some of the world's most wicked problems and exploring novel and exciting solutions along the way.

Alex Trembath: For this episode, we talked to Charles Mann. Charles is a historian and a journalist whose books include *1491: New Revelations of the Americas Before Columbus* and *1493: Uncovering the New World Columbus Created*. His most recent work is *The Wizard and the Prophet: Two Remarkable Scientists and Their Dueling Visions to Shape Tomorrow's World*. It's a book about how humans use science, technology, and policy to confront our impact on the planet and, ultimately, our own survival as a species. Charles offered an excerpt of his book to the latest issue of the Breakthrough Journal, which you can find on our website. In this interview, you'll learn what wizards and prophets are, why the scale of a given technology might be more important to us than the technology itself, and whether humans have a special role in the universe.

Alex Trembath: Charles Mann, thanks for joining us.

Charles Mann: It's my pleasure to be with you.

Alex Trembath: Your recent work has focused on humanity's place on earth, our use of science and technology. Your recent book *The Wizard and the Prophet* is populated by scientists and authors and philosophers, including Lynn Margulis, a biologist, who

likened humanity to bacteria in a petri dish. Can you tell us who Lynn Margulis was and what she meant by that?

Charles Mann: Lynn was a neighbor of mine. She taught at the University of Massachusetts, which is just down the road from where I live. She was one of America's foremost biologists; she won every award you can possibly imagine. Her specialty was the microworld of bacteria, protists, fungi, algae, and so forth. One of her great insights was just how extraordinarily various, numerous, and important they are. In fact, mammals like us are kind of like an epiphenomenon. She thought we were cute, but not actually important, when you're studying life as a whole. One of her most important points was that the rules of biology applied to everything. It was a kind of second Copernican Revolution. The first Copernican Revolution, as you probably know, is when Nicholas Copernicus said that the earth is not a special place in the center of the universe with its own special laws. It's just a dot among all the other dots that are all governed by the same physical laws. And to her, one of Darwin's basic ideas of evolution is that these natural processes and laws govern everything. There's no exceptions. People are not a special species in the center of the universe with their own special laws. We are governed by the same biological rules as protozoa in a petri dish, and that's why she said -- on a fundamental level -- there's no difference between them and us.

Emma Brush: Would you say that there's no fundamental difference between them and us?

Charles Mann: Well, that's the question right? Is she right? The question is more than just philosophical. I think it's interesting philosophically. Are we somehow special? Or as she liked to put it, "Oh, you think you're special? Oh, how nice." She said, "I bet you the mosquitoes think they're pretty special too, 'We're the only ones that bite people and transmit malaria,' right?" That was her sort of thing. You can always come up with some reason you're special, but are you in fact special? In some way that makes a difference.

Alex Trembath: Yeah, so what are the things that would make humanity special besides just sort of idiosyncratic traits that we have? Like we walk on two feet or other things like that. What are the things that might make humanity special?

Charles Mann: Well, she was fond of saying that the only thing, the only sort of physical property that humanity has, it really is exceptional, is we're really, really good at throwing. We are vastly better. I mean by orders of magnitude better at throwing than any other species on the planet. There's just nobody that can throw like us. A baseball pitcher is absolutely unprecedented on the planet, but aside from that she wasn't all that sure about it. This actually has some consequences, because one of the rules, in her point of view, is that most species are constrained by natural selection. You have the environment and enemies, predators and diseases, pathogens, and so forth, keep species more or less in place, but every now and then, a species jumps over the barriers of natural selection. When that happens,

they just explode and that's what the bacteria in a petri dish are. If you look, they just grow in this exponential unconstrained growth. She said, that's a successful species. You've successfully escaped natural selection, the bounds of it, and so she said we're doing that. Look at our unconstrained exponential growth and she said, one of the rules of biology is that these things always end badly. When the bacteria in the petri dish do this, they hit the edge of the petri dish, and then they either drown in their own waste or they exhaust their resources or both. That's the way it works. We're going to do the same thing. One time I was walking down the street with kind of a long face, because somebody in Congress had done something really stupid about climate change. She looked at me and said, "What's wrong?" I told her this and she said, "Well duh, do you think the bacteria in the petri dish that see the edge of the petri dish coming say, 'Oh we have to constrain our growth?' No, they just go right and hit it." That's what we're going to do, in her point of view.

Alex Trembath: Okay, but given that we are still increasing our absolute consumption of resources, many individual resources in particular, our population growth is actually not exponential. It may have been at one point in history, but it's actually slowing and it's likely to peak this century. We're pretty sure it's going to peak somewhere between 9 and 11 billion this century. Is that not an ironclad refutation of Lynn Margulis? Or would she have a rejoinder to that?

Charles Mann: Oh she absolutely would have a rejoinder to that. I brought this up with her and she said, "Tell me about this when we're not trying to supply everybody in Africa with Toblerone and not trying to have enormous amounts of fossil fuels being burned to cool people all over the world and so forth." She said, "From biology, the point is: how many resources are we consuming? Is there an infinite number of resources?" The answer is no, and this is sort of a form of Malthusianism obviously, but it was kind of a weird form in that she didn't regard this bad, as an example of humanity's greed. She just thought, this is what life does. Life doesn't have an off switch.

Alex Trembath: Yeah, and this is really interesting, and this is obviously something that we focus on a lot here at Breakthrough -- how can we decouple human impacts from human wellbeing? Both population size and resource consumption, and the productivity and efficiency of that resource consumption, which we think might be one of the things that make humans special. Obviously we can't predict the future, but a major goal of Breakthrough and ecomodernism is to accelerate these technological improvements in our consumption, so that something like a planet of nine billion people can consume like rich people do today. With actual decoupled and increasingly more efficient and lower per capita impacts. I want to focus on that concept a little bit and return to another metaphor in your book, the central metaphor, which is the wizard and the prophet. What is a wizard and what is a prophet?

Charles Mann: Okay. Well, basically, and on a certain level, these are the same kind of person, because they are people who are devoted to answering your question and saying, "In effect, Lynn is wrong. We can do all the things that you say." The interesting thing is, that when you look at people who do try to do this, to try to sort of figure out how we can make our way in a world of 10 billion, they tend to fall into two broad camps. I've called them wizards and prophets. Initially when I was looking at this, I sort of got the set of ideas on both sides, and I approached a friend of mine who's a philosopher, a college roommate who's become a professor of philosophy. I said, "This side over here, what should we call them?" He said, "Well, that's easy, they're Schumpeterian technophiliac meliorists."

Emma Brush: Alex!

Charles Mann: They're like Alex, right! And I said, "Oh, that's great. Isn't there some other word that I can use that wouldn't be like bludgeoning the reader?" He said, "Well, that's what they're called!" I said, "Okay, I'm going to call them wizards." These are people who believe -- and this is I think fairly closely, but not entirely aligned with the ecomodernist approach of Breakthrough -- that science and technology properly applied can allow us to produce our way out of these firms. We can essentially put on our thinking caps and make more. The emblem of that is Norman Borlaug, this amazing guy who is the main figure in what's been called the Green Revolution, which is the combination of hybrid seeds specially developed, high intensity fertilizers, and irrigation, that doubled, tripled, or even quadrupled grain yields across the world in the 1970s and 1980s. He's played a large part in saving hundreds of millions of people from starvation, an enormous event in our history. On the other side are the prophets, and Bob, my friend had an even worse name for them. I can't even, there's a big German word in the middle of it and I can't even pronounce it. I just thought, "I am not going to write a book with many words that I can't pronounce," so I called them prophets. They are people who argue that this approach is exactly wrong. That there's these natural limits, these natural processes, that we transgress at our peril. The figure here is, there's a guy named William Vogt, who's much less well known even than Borlaug. He was the author of the first modern 'we're all going to hell' book, and that is to say that we're just using too much too heedlessly. It's a kind of a Malthusian approach, except Malthus straight up said we can't grow enough food. He said, "We can, but we're going to wreck the ecosystems on which life depends." That's the fundamental argument of the modern environmental movement. We have to put on our cardigan sweaters and turn down the thermostat, and eat lower on the food chain. In other words, hunker down, because otherwise everybody will lose. If you think about it, these approaches are quite different from each other, even though both are united in saying that Lynn Margulis is probably wrong that we can do this.

Alex Trembath: Yeah, that's what really struck me about your book, having focused quite a bit on Malthusianism versus Copernicanism here at Breakthrough. The insight that we, most of us humans thinking about our future on earth, actually do think that we

have agency, that we are special. That we have some sort of special place in the universe. And that was fairly comforting to me, even as we're talking about a huge debate about resource use, about big global environmental problems.

Charles Mann: Yes, you're on the same side. One of the purposes in writing my book, I hoped, was to see that all the people who are arguing about these issues actually have this underlying unity, in this belief that we are special and in fact that this second Copernican Revolution is wrong. We are not like bacteria in a petri dish. That we do have something special, arguably related to our capacity to use reason and also our capacity to transform our social organization, in a way that ants can't or other very successful social species seem not to be able to.

Emma Brush: Who are some of the individual players in the kind of modern environmental movement today that embody the dichotomy? Maybe both that kind of fears opposition, but also this ultimate unity in the face of some sort of biological determinism?

Charles Mann: Well, I would say that you have a whole group of people who are primarily research scientists, but also some groups a little bit like Breakthrough that are on the wizard side. For example, in the book, I focus on the International Rice Research Institute, which was the place where the rice wing of the Green Revolution took place. It was directly inspired by Borlaug's work. The Rockefeller Foundation and the Ford Foundation put together an effort to do the same thing that Borlaug had done for wheat and rice in the early 1960s. It was spectacularly successful. Now something like 80% or 75% of the rice grown in Asia comes from IRRI, the International Rice Research Institute. Now that's the main staging ground for what's called the C4 Rice Initiative, which is a huge international program led in Oxford to change the way photosynthesis works in rice. It's an enormously ambitious scientific program to dramatically increase productivity in rice, which is of course the world's most important food stuff. The idea is that you should be able to grow more rice with less fertilizer, on the same amount or maybe even less land than we are using. That's a perfect example of the wizard's approach. The prophet's approach is all kinds of things. On the activist side, you'd have something like the Sierra Club, which basically regards itself as the guardian of the world's ecosystems. Then also something like the Nature Conservancy, which is essentially trying to buy and set aside huge tracts of land, so that people can't screw up the sort of vital ecosystems on which we depend.

Emma Brush: I think that makes perfect sense. I remember reading, shortly after your book came out, Bill Mckibben wrote a review – a very glowing review – of *The Wizard and the Prophet* in *The New York Times*. I would associate him with the prophets and maybe you'd disagree, but he points out that solar panels and wind power and the kinds of things that we might associate more with the prophet side, are actually quite technological and wizardly themselves.

Charles Mann: Yes, and the first thing I would say is that, it was an extremely nice review. The last thing I would want to do is be churlish enough to complain. He was very generous, and the other thing is, what he's talking about, is actually something I tried to clear up. This is a little bit of baseball, so I'm sorry to drag you into it. He read the galleys of course, and a couple of people I know read the galleys and raised the same objection. I realized, oh, I hadn't been clear enough. It's important to say that there's a secondary difference between the wizards and prophets: that the wizards typically favor giant, centralized facilities, which have enormous economies and efficiencies of scale. You have something like a single nuclear power plant, that if you do it right can provide power to huge numbers of people with a very small environmental footprint. The prophets really, really dislike this. I think that's their fundamental objection to nuclear power, or even beyond, the kind of prudential objections to the waste and the possibility of an explosion and so forth. What they want to see is a radically decentralized vision, where lots and lots of individual scale generators like rooftop solar, neighborhood-scale things, all swapping power back and forth. They see that as very democratic and leviathan, and they don't like it. They aren't ready to embrace technology. It's just the kind of technology they want to embrace is quite different than what the wizards see.

Alex Trembath: Yeah, that's fascinating. I have grappled with this question in my mind for a long time. When I think about the difference between something like a nuclear reactor and a solar panel, both are actually highly scientific machines. A nuclear reactor splits atoms and releases energy and radiation, and it is this strange, not-well understood scientific process among the general public. Sort of likewise with the photovoltaic effect, where you have photons hitting silicons, exciting electrons and generating electric current. I don't understand the difference in kind between those two scientific phenomena. As in, why one is viewed as more friendly and one is viewed as more sinister among the general public. What you're suggesting is it's not the science per se, it's the scale of the technology?

Charles Mann: Yes. Yes, and this is something that I didn't make clear enough in those galleys. Actually, the most substantial rewriting I did in the galleys was that, and I like to imagine that if Bill Mckibben had read that, he wouldn't. From this perspective, it's no mystery that when you have things like Ivanpah, which is this huge concentrated solar power experiment that's built in Nevada, where you have a zillion mirrors focused on a tower of salt and they melt the salt. The salt stays hot and it boils water and it drives a turbine and provides power to several tens of thousands of homes in Nevada. This has been bitterly opposed by environmentalists, and there's been much irony. "Oh, all environmentalists hate solar power!" Or in my home state of Massachusetts, where the environmentalists are the ones who put out a giant wind power installation. And what they're objecting to is the scale. Now maybe, on some level, you can say as a wizard, that's crazy, it's nonsensical. But if once you understand that the scale and the sort of centralization and the representation of big institutions in which you don't have very much local control, is the fundamental objection, then it's not a surprise.

Alex Trembath: Yeah, and that is a really interesting contradiction, or at least cognitive dissonance, that we find all the time.

Charles Mann: Also, I would like to add that the kind of blindness on this is on both sides. One of the amazing things to me is the debate over nuclear power, or the argument, or whatever you want to call it, which has gone exactly nowhere in 40 years. I mean if some time traveler were to take you from the late 70s and drop you off today, they would be astonished that the same people are saying the same things.

Alex Trembath: Right.

Charles Mann: Nothing has happened. What's really weird is that, well, you actually could meet in the middle. For instance, you could be talking about very, very small scale nukes, and we know plenty of them, very small next generation nukes. They could be presented as bridge fuels, bridge things, much as natural gas is. You could say, "Oh we're going to build this and it's going to be around for 30 years, and get us over the hump so that kind of voltaic stuff that we really like can be developed along with storage and so forth." That idea is never presented. In fact, if you talk to nuclear advocates, they get very huffy about it, as do the prophets. It's clear that you could, by being creative, meet in the middle, but people just don't want to do that.

Emma Brush: I'm curious, Charles, do you think by creating this kind of framework of wizards versus prophets, which is flattering to both sides in different ways -- I mean also maybe unflattering as well -- could that actually help bring people, self-identified wizards and prophets, to the table to actually discuss, "Okay, well, we understand our differing worldviews through this framework, but actually, it's time we start compromising?"

Charles Mann: Oh my gosh, yeah, that's my sneaky purpose. I mean, it's so pretentious I'm embarrassed to admit it, but it's true. I thought, if I could give a, how can I put it? An empathetic or some word like that, view, sympathetic, sympathetic worldview of both of them to try to explain what I think is going on, it might make them seem less incomprehensible to each other. That would facilitate dialogue, because I do think that the impasse and things like nuclear power or GMOs or you name it, has not been productive, to put it mildly.

Alex Trembath: Yeah, so on that note, what I came away from in your writing was that: there's actually at least some significant overlap in these worldviews. Not just in terms of human specialness, but in that sort of cognitive dissonance about the nature of technology, the scale of technology. I think that many of us have a little bit of a wizard and a little bit of a prophet. What is that composition for you, if you don't mind doing some personal reflection? Are you more wizard or more prophet?

Charles Mann: I think I'm probably like most people, which is to say, I'm confused and inconsistent. I'm certainly a person that has ridden on jet airplanes a whole lot, right, and I love living out here. I'm as implicated in the thing as anybody. What I want personally, why I live out here... I'm a science writer, so I'm really, really fascinated. I was totally intrigued by the C4 Rice Initiative and these other things, that in fact it was hard to prevent them from taking over the book, because I was so interested in it. At the same time, I live out here in the country and we have a very close to zero energy home that my wife designed. We have spaces to put batteries when they come down cheap, so we can kind of live off the grid, and we have a big garden. I'm sort of torn between these two things. I think actually that makes me in a weird way, a good person in a sense. I believe that either of these two visions could work. There's nothing that seems to me impossible about any of them, which is to say, they seem equally impossible. Again, take nuclear power, you have the vision of somebody like Michael Shellenberger, the guy who is associated with ecomodernism and is now running for governor of California. One of his big things he wants is to have a lot of nukes. He gives very strong environmental reasons for doing it. Basically they are these super safe, low-impact in terms of ecological footprint, form of zero carbon power, or very close to zero carbon power. The prophets of course hate it, they can say, "Well look, we can't even build those two big plants in South Carolina. How are you going to have 1000 of them built in the United States? That's impossible," right? I'm sure you've heard that argument. Similarly, on his side, he says, "We're going to have all these renewables and build all these storage facilities that don't exist yet, and then these super complex high transmission lines to shuttle power around for weeks on end between places that are cloudy or windless for weeks on end." Oh come on, that's the impossible. It seems to me, standing back, that they both represent leaps into the unknown, and of about equivalent size.

Alex Trembath: Yeah, and it certainly seems like no matter which direction the future progresses, we're going to have some mix of technology, some mix of scale. I wonder if that isn't a good thing, if at the same time that we're producing huge amounts of corn and soy in monoculture arrangements in the Midwest, that we have huge nuclear power plants and huge solar farms and wind farms in the deserts and the mountains. We also have some solar panels on our rooftopsm and we also have microreactors powering our cities. We also have urban gardens, and we also have local, small-scale low-yield organic farms, 10, 20 miles away. I'm thinking, really, of California right now, where I could go to an urban garden in Oakland, then I could go a little farther to the small-scale organic farms in Pescadero, and I could keep driving down Highway One and get to Diablo Canyon, the last nuclear power plant in California. I wonder if there isn't a virtue to all of these technologies and scales coexisting, because most people, almost no one on the planet, let alone California, are going to see Diablo Canyon. They might be able to actually touch and interact with the human intervention at the Pescadero farm scale. Or they might be able to install solar on the rooftop. Or they might be able to help build a small nuclear reactor in their cities, when those actually hopefully start coming online. I wonder

if there isn't some real powerful virtue into thinking of these technologies less combatively and more as part of this story that you tell. Which is, these are all different and we should not pretend that they aren't, but these are all different interventions and approaches that signal human specialness.

Charles Mann: I think that yes, that's obviously a very humane and plausible way, and of course it increases the system's resilience, because there will be some problems somewhere. The less we put all of our, what is it, cherries in one bowl, apples in one barrel? What is the appropriate cliché? The less we do all of the same thing, the less likely we'll be too vulnerable to some surprise. That said, I would point out two things about that vision. One is, I think there's going to be some mix no matter what, but it makes a lot of difference how much is on one side and how much is on the other. The world is becoming more and more urban and it makes a lot of difference whether the world is 70% urban or 90% urban. That makes a difference. The second thing is that we've had trouble coming up with the kinds of institutions, the kinds of organizations, companies, laws, regulations, and so forth that stimulate both. I tried to talk a little bit about that in the context of agriculture, where I point out that there's this farm that I went to visit that's a super, super productive "organic farm." The reason I say quote unquote is that, a lot of the very best farmers in this tradition actually don't like the organic rules, because they think of them as a kind of a snapshot of what somebody thought in the 1940s and don't have that much relevance to what we now know 70 years later. Anyway, Lloyd is this guy that, Lloyd Nichols, a remarkable guy. Super stubborn individual in northwest Illinois, and he has this farm that has more than a thousand different varieties of crops. What he's doing is, creating an artificial ecosystem, an agricultural ecosystem that has much of the complexity of a natural ecosystem. It represents an attempt to mimic natural processes and works within natural processes for human benefit. It's a huge technological enterprise, an enormous information management problem dealing with a thousand different crops. The information required for each one of these is just staggering. Plus there's a monitoring issue, plus there's, you can just imagine it, how complicated it is to run something like that. Let's not think that this isn't an alternative form of technology and it's highly productive, but it only exists because Lloyd is this remarkably stubborn guy, who works with fanatic determination. He's gotten zero state subsidies, zero local stuff from cities and in fact, his farm, from the legal point of view, doesn't exist, because there are these certain types of crops that you can get subsidies for. That you can get the loans for, that you can get the appreciation for, and he hardly grows any of them. Whereas his neighbors grow 1200 acres of soy and corn, there's an entire rack of local state and federal mechanisms designed to help them. They exist, kind of cradled in these institutions, and we've been just dreadful at designing institutions that will satisfy both sides. You see it in energy with the upcoming solar war, which utilities who have had a whole bunch of regulations that are favorable to them, are now seeing some regulations and rules and programs come up that are favorable to

rooftop solar and rooftop wind. Makes their life more difficult and they're starting to fight against it and trying to withdraw those mechanisms.

Alex Trembath: Yeah. I'm glad you bring up institutions and policy and practice and investment by individuals and organizations and governments. It seems like this will be a defining debate of the 21st century between wizards and prophets: how to scale, how to innovate in technology, how organizations like utilities or farmers' collectives will deploy and use technology. I think that's going to be really interesting to watch play out. My question is that all of that presupposes that we do have agency. Again, all of it presupposes that we are masters of our own destiny to some degree, even if there's nine billion of us. There will always be some conflict there. I guess my question is, if the opposite is true, if we're not special, then what would the practical implication of that even be? Would we cease having these debates? Would Margulis suggest that, because we're ignorant and we don't know the edge of the petri dish is coming, that we just embrace that ignorance and continue living the way we're living until we collapse? Or would there be some other way to approach policy in practice that biologists, or anyone who thinks that we're not special as a species, would promote?

Charles Mann: Well, I should immediately say in answer I'm going to tell you what I think Lynn would have said, but I didn't ask her this particular question. It's a very good question, I just didn't happen to ask her, so I'm going to tell you what I think she would have said, but of course I can't really guarantee that. I think she would have said, "No, no, we'll know the edge of the petri dish is coming, we just won't do anything about it."

Alex Trembath: Okay.

Charles Mann: There'll be people like you or Bill Mckibben for that matter crying and saying, "We could do this, we can do this, we can do this," and it just won't happen. That's actually an appalling idea. It is sometimes easy to believe in when you read the headlines today.

Emma Brush: Yeah, on that downward note, our last question would be, to try to end on an upward note: what kind of progress do you see in the world today, that would maybe counter Margulis' potential response to that question? What's a specific example?

Charles Mann: I'll give you two answers to that. One sort of narrower than than the other. Like, take climate change, which is sort of the issue I think that we think of when we think of inaction leading to disaster. Most Americans or elites certainly became first aware of the possibilities of disasters from climate change in the late 1980s with James Hansen's famous testimony to Congress. Then it becomes a really public issue somewhere in the late 1990s. That's depending on your point of view of the last 20 or 30 years. Then it's quite common to see environmentalists saying,

"How can we have been so slow? Why have we done nothing? We've had plenty of warning, right?" I think you've heard this. My perspective on this is a little weird. Take the fact that you can go to a drugstore today, a CVS, which is a big chain at least over here, I don't know if they're over there, and buy something on the shelf. There's a couple of things you know about whatever it is that you're buying on the shelf, for your headache or your cold or what have you. One is, that there's the ingredients that are listed on the label, probably there's a very good chance they match what's actually in the pills, right? The second thing is, that it probably won't kill you. Somebody has tested it to be sure it won't kill you, and the third thing is, for most people it will have some impact on whatever it's supposed to have some impact on. That if you have a decongestant, it will probably decongest you, and you know this, right? This is all because of the institutions that were set up, so how is it set up? It began in the 1880s with the explosion in quack medicine. This is when the idea that there could be medicines, they could do something, and they could be made by companies, came into existence. The vast majority of them were bogus. Some of them were actually toxic, with huge public outcry culminating in this country in the Pure Food and Drug Act of 1906. There was an enormous fight in Congress. At the end of it, this huge dust up, the Pure Food and Drug Act simply said that the ingredients in the bottle have to match what's on the label. They don't have to be safe, they don't have the effect, they just have to be labeled correctly. Reformers said, "Oh my God, this isn't nearly enough." They were proven right. There's a continuing big fight, they were proven right in I think it was 1938, with the elixir Sulfanilamide, in which a clearly correctly labeled medication said that the elixir Sulfanilamide had, I think it was arsenic in it. It was labeled on there and it killed a couple hundred people. Congress then passed the next version of the Pure Food and Drug Act. It said, they actually have to be not toxic. The Sulfanilamide people weren't, it wasn't possible to convict them of anything, because they had correctly labeled it. I mean it was incredible. They had sold poison. They had labeled it poison and people had taken it and died. They hadn't broken the law. It was only in 1962 that the Food and Drug Administration actually got the power to say something doesn't work, and therefore you shouldn't sell it for this. If it's a cold remedy, it actually has to do something for your cold. Okay, so that is 80 years, to get something that seems to me incredibly reasonable. Now, that is the actual scale in which things happen, I believe. Now look at climate change. In the 30 years, we've had enormous amounts of progress. Very excitingly to me, there's all these local, regional, and state initiatives. You guys in California know about this. Is it the California Auto Resources Board?

Alex Trembath: Air Resources Board.

Charles Mann: Air Resources Board, right, and the pact around that, that is preventing, so even if the current administration decides to undo the improved CAFE standards that Obama put in, the California standards kick in and so do the, I think it's 13 states that are doing this. 40% of the US auto market, plus the fact is that Germany, England, China, and a bunch of other countries are setting in motion the banning

of internal combustion engines in cars. Detroit has no choice. Detroit has to electrify. I see things like this happening, I think this is happening with unbelievable speed, compared to the standards, which we saw with the drugs. These are things that are actually killing people immediately. Those are some things that are going to be dangers decades from now. That's one answer, I think. The second one is, that I would say to Lynn, (A), we are responding. Look at all this happening. She would point to Donald Trump. I'd point to all the other stuff. The second thing I would argue is that, we have changed our lives dramatically in the past and this is something I talk about in the Breakthrough Journal. I mean, here we are, we have this room. You and I are talking, but in fact the producers are, I believe, two women. Is that correct?

Speaker 4: Yes, hi.

Charles Mann: Okay. Yeah, the people in charge, right, the producers. The people who are actually running the show. Or similarly, last night I had a dinner with a bunch of academics. There were four women and two men, and the women paid the bill. I mean this represents a change in human life that's absolutely enormous, which could have occurred nowhere on the planet in 1800. Or similarly, in 1800, that same dinner we would have had, in most places, the dinner would have been cooked by slaves or people who are a little better than slaves. That's just simply extraordinarily unlikely today. We are able to make these enormous changes in human institutions and have done so repeatedly in the past. This gives me a lot of hope.

Emma Brush: Yeah, well thank you Charles, thank you for that up-note and thank you for taking the time to speak with us today. It was a pleasure.

Charles Mann: Oh, I'm very interested in these subjects. I'll flap my gums about it all the time.

Alex Trembath: Thanks for tuning into this episode of Breakthrough Dialogues. If you liked what you heard, please tell your friends and subscribe on Apple Podcasts, Spotify, Stitcher, Google Play, Overcast, or whatever your favorite app is. Until next time, I'm Alex Trembath.

Emma Brush: I'm Emma Brush.

Alex Trembath: Thanks for tuning in.