

Justin Bullock: Welcome back to another episode of Bush School Uncorked. This is your co-host Justin Bullock. I'm here with my co-host Greg Gause-

Gregory Gause: And we are in Downtown Uncorked, in-

Justin Bullock: Historic Downtown Bryan.

Gregory Gause: Historic Downtown Bryan. Very good, Justin.

Justin Bullock: I botched it in our promo again. I will eventually remember that this is a historic place.

Gregory Gause: Yeah.

Justin Bullock: But until then, I keep botching it. And we have two lovely guests with us, that we'll introduce here shortly.

Gregory Gause: Lovely and talented.

Justin Bullock: Lovely and talented. And one last minute addition, which is exciting. We've shifted into a panel discussion, which will be a lot of fun for us, I think, this evening.

Justin Bullock: A couple of front matter things. We're going to do one more episode this season. We'll be recording here at Downtown Uncorked next Tuesday, which I believe is December the 10th, at five PM, if you would like to join us.

Gregory Gause: Five PM, not six PM.

Justin Bullock: Not six PM, which is what we've been doing.

Gregory Gause: Right.

Justin Bullock: And I think in the spring we'll probably go back to five PM.

Gregory Gause: That'll be fine.

Justin Bullock: This six PM slot has been a little late for Greg.

Gregory Gause: I'm old.

Justin Bullock: I'm keeping him up past his bed time.

Gregory Gause: Well, happy hour begins at five o'clock, so you know?

Justin Bullock: Yeah, so we should start then.

Gregory Gause: Yeah, exactly.

Justin Bullock: And as we said in our promo video, if you happened to see that, Ambassador Larry Napper will be with us next week and we'll be discussing Ukraine. Not specifically impeachment, but Ukraine policy and how it's interacted with the US. And then eventually get to why this has become a major talking point in the impeachment hearings, I'm sure.

Justin Bullock: With that we'll jump in. We have Professor Kent Portney and Professor Jonathan Coopersmith with us today. What I'm going to ask them to do is just situate their intellectual history and research, Kent Portney has been with us once before. But we'll give him an opportunity to do that, as well, again. And Jonathan Coopersmith, who's outside of the Bush School, we appreciate you joining us as an external member of the Bush School Uncorked family. And we'll hear from him as well.

Justin Bullock: With that, we'll jump right in. Kent, if you'd like to go first, just telling us how you think of the work you do and introduce yourself. We'll do Jonathan and then I'd like to talk a little bit about the work, the recent work, you've been doing at the Institute for Science, Technology, and Public Policy.

Gregory Gause: Okay, before we get to that, I do want to ask Jonathan to choose whether he's talented or ... What did you say, talented or-

Gregory Gause: Lovely.

Justin Bullock: Lovely.

Gregory Gause: Lovely and talented.

Gregory Gause: You choose. Are you the talented one or the lovely one?

Gregory Gause: No, no, you're both lovely and talented.

Gregory Gause: Really? Half and half.

Gregory Gause: Yeah.

Jonathan C.: But the question is-

Gregory Gause: Yeah?

Jonathan C.: Are we speaking backwards and wearing high heels?

Gregory Gause: You really want to go there?

Jonathan C.: It worked for Ginger Rogers. And my claim to fame is that my brother once danced with Ginger Rogers.

Gregory Gause: Really?

Justin Bullock: Okay.

Gregory Gause: That's your claim to fame?

Jonathan C.: Well it's the closest I'm going to come to being called talented and lovely.

Justin Bullock: And who is Ginger Robins for those-

Gregory Gause: No, Ginger Rogers.

Gregory Gause: Ginger Rogers.

Jonathan C.: Ginger Rogers.

Justin Bullock: Ginger Rogers, come on, I'm the millennial.

Gregory Gause: She danced with Fred Astaire in numerous movies. She did everything Fred Astaire did but backwards in high heels.

Speaker 6: Backwards. Exactly.

Gregory Gause: That's what she said.

Jonathan C.: And this was at a fundraiser and my brother was substituting for my father. And he was in college then, and he was seated next to Ginger Rogers. And like you, he had the innocence, or ignorance, of youth. And all evening these men kept coming up, who were more, older, distinguished men. Professor types at the Bush School, for example. And asking her to dance. And she kept politely declining. Until she found out that my brother didn't know how to ballroom dance. And she said, we'll change that.

Jonathan C.: And you know those moments in the movies, moments in the movies where everybody freezes and all of a sudden the spotlight is-

Gregory Gause: Uh huh, uh huh.

Jonathan C.: It's the same thing. She takes this college student, who doesn't know ... And they sweep around the floor, and I think that's the time I've really been most envious of my brother.

Gregory Gause: Yeah, I'm envious of your brother.

Gregory Gause: Is it videoed? Can we confirm this stuff?

Jonathan C.: No, this was back in the last century before there were smart phones. Nobody was there filming it, they were just ... You know, the men were in total awe. And my brother was just saying, what am I doing?

Gregory Gause: She was leading?

Jonathan C.: She was leading.

Gregory Gause: That's great.

Jonathan C.: Backwards and in high heels.

Gregory Gause: Yeah.

Jonathan C.: And setting the standard, even then.

Justin Bullock: I've already learned something.

Gregory Gause: That's a good story. That's a good story.

Justin Bullock: I've already learned something.

Jonathan C.: But if you have not seen a Fred Astaire and Ginger Rogers film you should. You know?

Justin Bullock: Okay, I'm sold.

Jonathan C.: Pay no attention to the plot. Because if you do, you'll be in trouble.

Gregory Gause: You won't appreciate the dancing.

Jonathan C.: But the dancing. Yes, the dancing is just spectacular. As is the scenery and remembering that this is a lot of this is done 1930s during the Depression. This was escapism at it's best.

Gregory Gause: Absolutely.

Justin Bullock: My only reference point for dancing from that time period is Jimmy Stewart from It's a Wonderful Life as the-

Gregory Gause: The pool opens.

Justin Bullock: As the pools open and they're dancing and the light's on them, and then they fall in. That's my only reference. Sorry guys.

Gregory Gause: All right.

Jonathan C.: You know what, you need to develop your education.

Gregory Gause: Yes.

Gregory Gause: But Kent, about your work.

Gregory Gause: All right, my work has spanned quite an array of topics and policy areas. I think of my own work as being focused on urban sustainability, that's where my passion is. But since I've been director of the Institute for Science, Technology, and Public Policy, we've gone into many other areas, as well.

Gregory Gause: Now I understand that previous Bush Uncorked speakers have talked about city stuff, so I'll take all of the city work that we're doing off the table. We won't talk about any of that. But I came prepared to talk about three other projects that we have underway right now. And I'll be happy to describe those and then we can turn it over to Jonathan and say, which one do you like? If any.

Jonathan C.: Yeah, yeah.

Jonathan C.: One from column A, one from column B, one from column C.

Jonathan C.: Yeah.

Gregory Gause: Or we can do that, yeah.

Justin Bullock: So John, maybe give us a little bit ... We haven't had you on the podcast before. I think the listeners have heard a little bit of Kent's background before. Tell us a little bit about your intellectual background.

Jonathan C.: Well, you're in Historic Downtown Bryan. There's your spot.

Justin Bullock: There's my history reference, yeah.

Jonathan C.: And you need a historian. By the most amazing of coincidences, I happen to be a historian. I'm a historian of technology. I've done a wide range of research. I can tell you the location of every light bulb in Russia in 1880.

Justin Bullock: How many were there?

Jonathan C.: There were about 900 of them. And I can also tell you why that mattered. Because back in 1880, if you owned a light bulb, it wasn't just that you owned a light bulb, you also owned the generator, you owned the wire, you needed a mechanic.

Justin Bullock: Right.

Jonathan C.: In other words, it was like having a super computer.

Justin Bullock: Hey, can I ask Greg how many light bulbs there were in the US at that time?

Gregory Gause: I have no idea.

Justin Bullock: Oh that was before you?

Gregory Gause: Yes.

Justin Bullock: Ha ha.

Gregory Gause: He didn't have one.

Justin Bullock: Ha ha ha.

Jonathan C.: Right. But the reason, no, with the light bulbs, I was looking at the list and this was when I was a graduate student. My dissertation on Russian electrification. I was thrilled for a couple days. Wow, what could be more useless than the list of light bulbs. And then I looked at the list, and I realized that these were in places like the gunpowder factory, Fort this, the Naval Ship [inaudible 00:08:23]. And suddenly I realized, oh, the fact that many of these were in military installations and that many of the electrical engineers at the time had titles like Captain or Major in front of them, made me realize, unlike the United States, the infusion, or the development, of electric lighting in Russia, was pushed by the military.

Gregory Gause: Top down, not bottom up.

Jonathan C.: Top down, bottom up.

Gregory Gause: They'll market to-

Jonathan C.: Weak civilian economy. Military here. Just like super computers in the 1950s, in the US, and '60s. Pushed by the military.

Jonathan C.: I'm a historian of technology. I worked on Russian electrification, done a history of the fax machine. Role of technology in pornography. The role of pornography in technology is equally good. I do a lot of work on failure. And my current work is with the anti importance of fraud, froth, and fear in emerging technologies.

Justin Bullock: Fraud, froth, and fear. All right, I want to come back to that, because I want to learn more about that.

Jonathan C.: So do I.

Justin Bullock: Excellent. Kent.

Gregory Gause: Yes.

Justin Bullock: Let's hear these three different things that maybe the Institute for Science and Technology and Public Policy has been working on that would be interesting for us to dive in first.

Gregory Gause: Okay. Let me start with, I'll leave the one that I think we'll end up talking about for last.

Justin Bullock: All right.

Gregory Gause: One of the projects we've been working on is on, what I call, the Water, Energy, Food, Nexus Governance. The engineering world has been taken by storm by this idea of a nexus, or connection, between water, energy, and food. And, most of the research that's been done has been trying to document how much energy it takes to produce water. How much water you need to produce energy. How much water you need to produce food, and so on.

Gregory Gause: They have actual numbers. They say you need X number of gallons to do this or that. Nobody, until we got involved, was interested in the governance of those resources. And how the governance and the resources might be coordinated, or uncoordinated, and what the implications of that would be.

Gregory Gause: We've done a big project on that. Continuing to do that project.

Gregory Gause: The second project ... Why don't I just jump to the one that I think we'll end up talking about, which is, we've been working for the last year and a half on a project involving what we call gene drive. Gene drive is the use of genetic editing, gene editing, to change the whole population of some kind of critter. Usually for the purpose of wiping that population of critters out.

Gregory Gause: And our focus is on four different critters, in the state of Texas, that have implications for agriculture. It involved the boll weevil. The boll weevil has undergone an eradication program for many decades. It's been relatively successful with traditional methods, except in South Texas. And the boll weevil is now starting to make a come back. Concerns a lot of people.

Gregory Gause: Second one is called Indian Meal Moth. That's the moth that gets in your food. You know, you ever get some flour in your cupboard and you end up with these moths?

Justin Bullock: Yeah.

Gregory Gause: You know, you look at, oh I don't want any. They won't hurt you. Good source of protein.

Jonathan C.: And they're organic.

Gregory Gause: And they're organic. But, nobody wants them, so-

Gregory Gause: Who wants to eat a piece of bread that has a moth stuck in it.

Gregory Gause: I wouldn't mind, but-

Jonathan C.: It's protein.

Gregory Gause: It's protein.

Justin Bullock: Crunchy.

Gregory Gause: You know the food industry-

Jonathan C.: Grasshoppers are better.

Gregory Gause: The retailers, the wholesalers, they don't want the stuff in their flour, in their grains.

Justin Bullock: Yeah.

Gregory Gause: The third one is something called pigweed. Pigweed is a weed that's hard to control, in agriculture, crowds out food crops. And the only way to kill it right now is with our favorite pesticide called Round Up.

Gregory Gause: Ahhh...Round Up.

Gregory Gause: And we know, not only is Round Up bad for you, but it's losing it's effectiveness. Pigweed is adapting to the application, and becoming more and more resistant to it.

Jonathan C.: Like antibiotics.

Gregory Gause: I think there's probably an analogy there. The fourth critter is the mosquito that promises to carry what's called Rift Valley Fever. Rift Valley Fever has not shown itself in Texas, yet, but the cattle industry in Texas is scared to death, that it might show up. And if it shows up, it can wipe out the cattle industry in no time at all.

Justin Bullock: Wow.

Gregory Gause: It's present in the Rift Valley of Africa. It has done major damage to that cattle populations. And if it were to show up in Texas, it would be devastating to them. And of course, cattle industry is probably second, only to, what Greg? In Texas is a-

Gregory Gause: Is it oil?

Jonathan C.: What is oil?

Gregory Gause: Oil, yes.

Jonathan C.: Not football?

Gregory Gause: I forgot about football.

Jonathan C.: How can you forget about football?

Gregory Gause: I'm not going to go there.

Jonathan C.: Well, maybe after last week's loss you want to forget about football.

Justin Bullock: Yeah, that's true.

Gregory Gause: Our project is working with a bunch of entomologists to interview stakeholders, stakeholder groups, to find out how people understand, or may understand, this idea of controlling these populations. And to understand what kinds of risks people would be most concerned about, if efforts were actually made to do the gene editing.

Gregory Gause: The gene editors, mainly in the entomology department, but elsewhere as well, say they're getting very close to being able to edit the genes of these critters, so they can wipe out the whole population.

Gregory Gause: So, you splice...you edit the genes?

Gregory Gause: Yeah.

Gregory Gause: You introduce a number of, let's say the mosquitoes, with this genetic modification-

Gregory Gause: Yes, introduce to the population, they mate.

Gregory Gause: They mate and, in essence, the mating doesn't work and the population disappears.

Jonathan C.: It's sort of like sterilizing flies, but this time it's actually genetic.

Gregory Gause: And it passes the genes on.

Jonathan C.: On, right.

Gregory Gause: When you sterilize critters now, it doesn't pass the gene on, it just kills the ones that are there.

Gregory Gause: It doesn't pass the genes on, right.

Gregory Gause: Gene drive is not legal in the United States.

Gregory Gause: It's legal experimentally? I mean, people in the entomology department are not breaking the law by doing these experiments?

Gregory Gause: Not so far.

Gregory Gause: Okay.

Gregory Gause: The experimental research is being done mostly in Europe. And most of it is being funded by the Gates Foundation. The target of most of that right now is the mosquito that carries the ... Help me. The virus-

Justin Bullock: West Nile?

Gregory Gause: West Nile?

Gregory Gause: No, no, the African-

Gregory Gause: Dengue Fever?

Gregory Gause: No. I'm having one of those-

Jonathan C.: Rift Valley.

Gregory Gause: Senior moments.

Gregory Gause: Malaria, thank you.

Gregory Gause: Oh Malaria.

Jonathan C.: Malaria.

Gregory Gause: Malaria.

Justin Bullock: This is what we need an audience for.

Gregory Gause: Thank you.

Gregory Gause: Yes, thank you.

Gregory Gause: The Gates Foundation is investing tens of millions of dollars in the research.

Gregory Gause: Oh right, the Gates Foundation, Malaria. Eradication and what not.

Gregory Gause: And they're doing it in Europe because they have a different regulatory regime than the United States does.

Gregory Gause: And Malaria's interesting here, because we have ... The previous effort to eradicate Malaria was done through DDT.

Gregory Gause: Right.

Gregory Gause: Which in the '40s and '50s was a miracle drug. Right?

Gregory Gause: Right.

Gregory Gause: It wiped out these mosquitoes, people lived a better life. And then we found out that DDT had these-

Gregory Gause: Unintended-

Gregory Gause: Unintended consequences, side effects in the environment. And that's the question, will these gene splicing experiments have these side effects in the environment?

Gregory Gause: That's right. There's no way, as Jonathan can tell you, there's no way to be sure that something like this would not have unintended consequences.

Gregory Gause: Right.

Gregory Gause: It's a matter of-

Gregory Gause: In fact you can almost, rest assured, that it will have unintended consequences.

Gregory Gause: Well, depends on who you talk to.

Gregory Gause: But how serious and how dangerous they are.

Gregory Gause: You can imagine the primary and secondary consequences that could arise. It lets your imagination go wild.

Jonathan C.: That's why you have science fiction writers.

Gregory Gause: That's right. That's right.

Jonathan C.: And one of the big differences with previous efforts is that unlike sterilization, which is just going to effect that particular critter, to use the technical name, you're editing the gene drive. You're making this for all generations.

Gregory Gause: That's right.

Jonathan C.: And you know-

Gregory Gause: Now, some of the people who do the genetic research say that there might be a way to do the gen editing so that it can be reversed.

Gregory Gause: You can reverse gene editing?

Gregory Gause: That's what some say. You can do it. But nobody has actually done it, even in a laboratory.

Gregory Gause: Yeah.

Gregory Gause: And right now the laboratory experiments have graduated to the point where they're just trying to find out what it takes to promulgate the genetic change into a larger population. Not in the real world, but in a controlled setting.

Gregory Gause: Right.

Gregory Gause: So, we're doing this research to find out what are people's concerns?

Jonathan C.: What sort of people are you talking to? Or talking with, sorry.

Gregory Gause: We've got a list of about 250 stakeholder organizations in Texas.

Jonathan C.: Okay.

Gregory Gause: That includes government officials, people from industry, people in the farming industry, farm workers. We're very interested in understanding how farm workers and farm workers organizations respond to this idea.

Gregory Gause: Keep in mind that while there could be unintended negative consequences, the promise is you can substitute this for the widespread use of pesticides.

Jonathan C.: Right.

Gregory Gause: Right, yeah.

Gregory Gause: Which are not benign to the environment. Or to human health, right?

Jonathan C.: Right.

Gregory Gause: There's at least a promise there that you can do away with Round Up and other pesticides, by getting this right.

Gregory Gause: If you can get rid of the pigweed without Round Up, that would be a great thing.

Gregory Gause: That's right.

Jonathan C.: Yeah.

Gregory Gause: There are a bunch of other kinds of issues, such as there's a strain of the plant, that we call pigweed, that's grown in Mexico for food. It's a food crop.

Gregory Gause: Wow.

Justin Bullock: Interesting.

Jonathan C.: You could accidentally destroy-

Justin Bullock: A food crop.

Gregory Gause: People's food source.

Jonathan C.: Yeah, which, yeah. And you can easily assume what happens when bad guys, if you get the gene drive sufficiently developed, what can ... Bad guys could say, instead of eliminating with fever, let's push it.

Gregory Gause: That's right.

Justin Bullock: That might be a nice tie in to this fear, froth, and failure idea. What kind of things are thinking about in, Jonathan, as that research? Are there some examples of technology that fit in with that topic that you could let us know about?

Jonathan C.: Okay, basically the premise of my research now is ... Okay, you're too young to remember when Amazon came out or ... Right.

Justin Bullock: That's true.

Gregory Gause: Let the record show, these topics [inaudible 00:20:32].

Jonathan C.: Let the record show.

Gregory Gause: Thought he was talking about the Amazon River in Brazil, right? I had no idea what he was talking about.

Justin Bullock: You can order books online and other things now, Greg.

Gregory Gause: So I understand. So I understand.

Jonathan C.: It's sort of a scaled up version of rural free delivery on steroids.

Gregory Gause: Yeah, yeah.

Jonathan C.: No, but the idea, here's this company's technology, that promised it was going to revolutionize reality, and it did. It's emerging technology, there's lots of hype. And part of my argument is that for every Amazon that succeeded, there are scores of companies that failed. And with a few exceptions, they didn't set out to fail.

Justin Bullock: Yeah.

Jonathan C.: But they actually thought they could do this. And the evolution of a exciting, revolutionary technology is going to be, has to be accompanied by lots of firms that are going to fail. That are adding to the excitement, that are adding just, legitimation.

Jonathan C.: Think about General Motors investing, or Ford, investing lots of money in autonomous vehicles. And that's where the fear comes in. Because GM is asking its engineers, what do you think of these self driving vehicles? And the engineers are saying, yep, I mean give us enough money and enough time we'll come up with something. But it's not really ready yet. And the CEO is saying, okay, my people are saying not quite yet, but what if they're wrong? Let me invest some money in that. Because I'd rather ... Because the consequences of being wrong are far more serious than investing a few millions, or tens of millions, of dollars and be-

Gregory Gause: So the fear part is FOMO, fear of missing out?

Jonathan C.: Right. Fear of missing out, that if we don't do this and our competitors do this and it works out, we're messed up.

Jonathan C.: And by the way, because GM is investing this, that adds legitimacy to the broader field, as well as drives up the price incentives and more resources.

Jonathan C.: The fraud is very rare, it includes self fraud, as well as ... I really do believe in this. Hey, you've got your finger on this scale. Don't you realize that?

Jonathan C.: And then you've got semi-fraud. My favorite example, actually my two favorite examples, one is from around 1800 when Eli Whitney demonstrates he's really created interchangeable parts for muskets. Which from a military perspective, and military again, is really important because it means very simple battlefield repairs or off battlefield repairs. You don't need skilled mechanics to fix your musket. He demonstrates these parts before an audience, includes the vice president, the secretary of war, several others. And Whitney, at this point, is years behind the contract. He's over budget, some things don't change. And the parts-

Gregory Gause: Is it before or after cotton gin?

Jonathan C.: This is after cotton gin.

Gregory Gause: Okay.

Jonathan C.: Because one of the things Whitney has learned is that it doesn't do you any good to patent a device that once you are told how it operates, anybody can make.

Gregory Gause: Right.

Jonathan C.: In a country with weak patent laws and very good lawyers. Whitney is saying, if I get a government contract, and I get a monopoly on what I'm doing, I can make money.

Jonathan C.: And Whitney gives a demonstration and everybody says, Whitney you're a genius, how much money do you need? Come back when ... Instead of this two year contract, it's 10 years. Wonderful. About 160 years later, some Smithsonian researchers are looking at these muskets and they say ... And they're using microscopes or what can, and they say, whoa, these parts are interchangeable, that's true. But Whitney said he was making them in this one way and he didn't, he rigged the demo.

Justin Bullock: That's really funny, yeah.

Jonathan C.: And that's a bit of fraud on the government, in this case.

Jonathan C.: Give you another example, was it 2007, Steve Jobs gives the first iPhone demonstration. And six years later it's revealed that that demo was rigged. That you saw the back of the screen, five bars that had no bearing to what it was actually receiving.

Jonathan C.: There was another cell tower put into the reception. And when he walked around picking at the iPhones, each of them was optimized for that specific part. Now, was that fraud? In some ways, no, because they knew that, well, give us a bit more time and we can fix these flaws. And almost any company, they'll have war stories about the dog and pony shows where you've got Harry out front demonstrating the gadget, and in back Mary's holding two bare wires together.

Gregory Gause: That doesn't seem to apply ... Elon Musk recently-

Justin Bullock: Yeah, with the truck. Did you see the-

Gregory Gause: With the truck.

Justin Bullock: The indestructible windows.

Gregory Gause: It was just bad fraud.

Jonathan C.: Yeah. Well, no, it was just they didn't set it up proper.

Justin Bullock: Ineffective.

Gregory Gause: Yeah, yeah.

Jonathan C.: Well, he says, look, we know they're a problem, but give us a bit more resources, a bit more time, we'll fix them.

Justin Bullock: Yeah, yeah.

Jonathan C.: This isn't the sense of Musk not saying I'm going to come up with a truck that any sledgehammer could kill. Not quite ready but we have to give a show. That's a bit of the self fraud.

Jonathan C.: And the froth is, golly, everybody is saying bitcoin is the wave of the future, block chain. I want to start a block chain company, too. And you have, these create a bit of hype, a bit of excitement. A bit of, a lot of action. Investors are attractive because, wow, this is the wave of the future. I know this because George Foreman told me so.

Justin Bullock: Yeah.

Jonathan C.: But that brings in a lot of money and it brings in more engineers. It brings in people saying, I should get into bitcoin, our company should.

Gregory Gause: Justin has jumped into ... Did he say?

Jonathan C.: No.

Gregory Gause: He's got Bullock Bits.

Jonathan C.: Bullock Bits.

Justin Bullock: Bullock Bits. One thing about the fear that I wanted to bring back to the genetics stuff, is what kind of fears do the stakeholders have in the conversations that you've been having in the stakeholder analysis? Because genetics in particular has kind of a storied history that might cause people to be a little afraid of them.

Justin Bullock: If we could come back to the history part, but what are some of these stakeholders saying as part of their worries, or opportunities, with the gene drive?

Gregory Gause: Well, as you can imagine, the number ... Well, maybe not. I mean, we went into this with the idea that a significant number of people would be concerned about this as playing God, right?

Jonathan C.: Mm-hmm (affirmative).

Gregory Gause: Really getting involved with ... And it turns out nobody seems to be concerned about that.

Gregory Gause: Is that because it's about mosquitoes and pigweed?

Gregory Gause: Well, I think so.

Jonathan C.: Yeah.

Gregory Gause: I think people are tending to this kind of cost benefit analysis in their heads. And what they're really concerned about is the unintended consequences and how to minimize the chances, not eliminate, but minimize the chances that there will be unintended consequence.

Gregory Gause: The dilemma, from a policy perspective is, we want to know, do they have any confidence that there's any regulatory agency that will do it right. Whatever that means.

Jonathan C.: Right.

Gregory Gause: And the answer is, not too much. You know?

Gregory Gause: Is there a difference between ... Do they think that the federal government would do a better job, than state government? Is there a sense of the level of which there might be trust?

Gregory Gause: There's no understanding of the difference, to be honest with you.

Gregory Gause: Okay, okay.

Gregory Gause: Right now the regulatory regime, if you would call it that, is pretty fragmented in Washington. There are three primary agencies that each claim to have some authority for the eventual regulation of aspects of this. The Food and Drug Administration, but only for food crops.

Gregory Gause: Right.

Gregory Gause: The US Department of Agriculture, and the ... What's the third one? Tell me. The EPA.

Gregory Gause: The EPA, right, right.

Jonathan C.: Yeah.

Gregory Gause: They have an internal working group, where they meet periodically and then argue about who has jurisdiction over it.

Gregory Gause: Welcome to government.

Gregory Gause: Yeah, really. It will eventually take-

Gregory Gause: Congress is going to have to-

Gregory Gause: Yes.

Gregory Gause: There's going to have to be legal-

Jonathan C.: Some.

Gregory Gause: Some kind of legal movement on this.

Gregory Gause: And there was an effort a couple of years ago, in the federal farm bill, to get this process started.

Gregory Gause: Right.

Gregory Gause: To allocate responsibilities and authorities, and it was defeated in congress.

Gregory Gause: Really?

Gregory Gause: It was not passed in the senate.

Gregory Gause: We've had genetic modification in crops for a long time, right?

Jonathan C.: We've been doing that for thousands of years, only we haven't called it genetic modification.

Gregory Gause: Good genetic modification.

Jonathan C.: But that's what ... If you've been raising dogs, or breeding cattle-

Gregory Gause: Hybridization.

Jonathan C.: Hybridization.

Gregory Gause: Yeah.

Jonathan C.: We've been doing that for thousands of years.

Justin Bullock: The difference now is the type of tools and precision with which we can do it, right?

Gregory Gause: Yeah, the CRISPR-Cas9 technology has really, fundamentally changed the world.

Gregory Gause: Who is in charge of regulating genetic modification of crops? FDA?

Gregory Gause: The Food and Drug Administration would have primary responsibility.

Gregory Gause: Okay.

Jonathan C.: Yeah.

Gregory Gause: But the US Department of Agriculture says, hey, wait a minute, we have something to do with this, too.

Jonathan C.: And okay, I apologize.

Gregory Gause: Go ahead.

Jonathan C.: But are they making a distinction between altering genes, existing genes, which is assuming what the gene drive will be and the GMO, the genetically modified organism, where let's bring in some outside genes? That's-

Gregory Gause: Well, of course, they do make a distinction. But with gene drive, it's really about ... I haven't gotten into all the gory details about it. But it's really about effecting-

Jonathan C.: Turning on and off existing-

Gregory Gause: But reproductive capacity, for only those kinds of critters, to use your technical term, that reproduce sexually. That's the only plausible way that gene drive could wipe out a population.

Gregory Gause: How does it effect the pigweed?

Gregory Gause: Pigweeds reproduce sexually.

Gregory Gause: Okay.

Gregory Gause: Good question, Greg. Paying attention, yes.

Justin Bullock: You're a good host.

Gregory Gause: You know, pigweed's not a mosquito.

Gregory Gause: Right, this is true.

Justin Bullock: Uncontroversial. That's the most uncontroversial thing you've said on the podcast.

Gregory Gause: Thank you.

Justin Bullock: Why might people, to throw back to our historian, and I'm sure people have some sense of this, but why is genetic modification, or changing animal's genetics, something that is controversial from a historical standpoint? Is there an example from history, where trying to do some genetic modifications was maybe done in a way that is unethical?

Jonathan C.: Short answer's yes. No, one you've got the example of the eugenics movement. Playing god with people. And by the way they're ... Which is very popular, world wide in the '20s and '30s. Indeed Nazi Germany took some of its eugenic principles from laws that were passed in the United States.

Gregory Gause: That's right.

Justin Bullock: Say that again, say that again.

Jonathan C.: Nazi Germany took some of its ideas for its eugenic laws from laws in the United States.

Justin Bullock: That's what I thought I heard.

Gregory Gause: Many people in the progressive movement were enthusiastic about eugenics. Theodore Roosevelt.

Jonathan C.: Yeah, basically better breeding ... Better breeding of humans. Again, this had both positive and negative aspects. The positive, let's provide better living conditions. Let's provide good diets. Let's ... You know? But at the same time, they may have well ... Let's prevent those people from breeding.

Gregory Gause: Wasn't it Oliver Wendell Holmes who said in a Supreme Court decision, five generations of idiots is enough, on forced sterilization?

Jonathan C.: Yeah. Forced sterilization, occurred in several US states through the 1970s.

Gregory Gause: Sure.

Jonathan C.: The Swedish government, tens of thousands.... And who gets sterilized, it's usually poor minorities of some kind or another. You have that aspect. You also have the playing God fear. And you see this with GMOs, genetically modified organisms. Where scientists, a lot of that has been adding extra genes, or adding external genes, and seeing what happens. And you can get some really neat genetic art that's been created. Artists putting in fluorescent genes in this or that.

Justin Bullock: That's cool, yeah.

Gregory Gause: Frogs or-

Jonathan C.: Frogs.

Justin Bullock: Yeah.

Jonathan C.: And in some ways, again, we've been modifying organisms, we've been modifying plants, for thousands of years. Some of that's been through breeding in the last century. A random experiments of, let's use x-rays to create ... Let's use radiation, another scary word, to try to modify genes and see what happens.

Jonathan C.: What GMOs are doing is much more targeted modification. There are a lot of people who had ... And there have been examples of, we're going to eliminate Malaria, we're going to eliminate this creature, that creature, once and for all. And DDT was great. Oh there are all these side consequences, that we didn't really realize.

Jonathan C.: There's a lot of, some cases justified and in some cases unjustified, fear of the unknown. And one of the challenges of anytime you're going to be doing a gene drive of transforming not just this generation, but all generations, of these critters, or these consenting plants-

Justin Bullock: Consenting plants.

Gregory Gause: You ask the pigweed, will it be okay for us to alter your genes? And the pigweed nods.

Gregory Gause: It's not you, it's the research, [inaudible 00:36:27].

Jonathan C.: Okay. Is what happens if we get something wrong, and how would we know? And if I remember correctly, some of the early proposals for, not so much in the US, but other, can we test this on a deserted island? Or not a deserted island, can we test this in a place where, oh golly, we didn't think of that. You haven't laid waste to all of Arkansas.

Justin Bullock: What's one interesting way this is playing out now, bringing it to the human realm, there's been a really controversial case, out of China, where I think the gentleman's name was [Hee 00:37:10], and there was genetic modifications made to twin babies in China to make them more resistant to HIV.

Justin Bullock: And then there was a publication that came out that was, it's going to shorten their lifespan and then that paper had to be retracted. This is I think where some of the concerns about playing god really ... It may not play out as much in the mosquito, but when you start altering humans, these concerns, I think, pop up in full force.

Gregory Gause: But we're jumping quite a bit from the kinds of projects-

Gregory Gause: Plants, that's right.

Gregory Gause: That Ken is talking about.

Gregory Gause: In fact, the use of gene editing on humans is not legal.

Justin Bullock: Correct, yeah, yeah, yeah.

Gregory Gause: Not legal in the United States.

Gregory Gause: No, it's not legal worldwide.

Jonathan C.: Even in China?

Jonathan C.: Even in China.

Justin Bullock: Right, yes.

Jonathan C.: I mean the Chinese reaction. In Russia there's been a geneticist who's been talking publicly about this, not so much as ... What's the regulatory response?

Gregory Gause: Right, exactly.

Jonathan C.: And this is something that's going to happen. As the technology becomes more democratized, as it becomes easier to do. And by the way, CRISPR has been refining itself over the years. And one of the challenges, there is a huge difference between pigweed and people.

Jonathan C.: But in the larger political aspect, if you want to scare somebody or get him, say the words GMOs, or radiation. But, some of us are old enough to have had MRIs, Magnetic Resonance Imaging. The original name of the MRI machine, was NMR, Nuclear Magnetic Resonance. And that was changed because they said, oh, if it has the N word-

Gregory Gause: The nuclear thing scared them off.

Jonathan C.: It, really. But oh, magnetic resonance, same.

Gregory Gause: The technology hasn't changed, just the way they call it

Jonathan C.: The technology ... Just the wording.

Gregory Gause: Just what they call it.

Jonathan C.: One of the challenges of gene editing, for these nasty critters, is this going to get caught in a larger, less informed, vaguer debate?

Gregory Gause: Sure, that's exactly right. But there are some legitimate concerns that people have. Particularly around the control of the technology and of the gene drive by private sector.

Gregory Gause: This is something that's come through loud and clear, even in Texas.

Gregory Gause: Wow.

Gregory Gause: That people are very wary of major corporations gaining control of the technology, for the purpose of changing the genes of critters. Not to wipe out the population, but to make them more susceptible to their pesticides, or their fertilizers, or the same sort of thing.

Jonathan C.: Soy beans.

Gregory Gause: Yes, exactly.

Jonathan C.: Monsanto.

Gregory Gause: There's plenty of precedent out there.

Gregory Gause: What did Monsanto do to soy beans?

Gregory Gause: Corn and soy beans.

Jonathan C.: Corn and soy beans.

Gregory Gause: Corn and soy beans, okay.

Jonathan C.: If I, correct me if I'm wrong. But they basically modified, genetically modified soy beans to be more resistant to Round Up, so that Round Up could be applied-

Gregory Gause: Could be used on the weeds, and the soy beans would survive.

Jonathan C.: Right. And one of the aspects, this is from a corporate short term profit perspective, it was brilliant. It worked. But from a setting the pace of, oh this is a technology that big corporations are using to maximize profits, as opposed to what if we had developed our first product for golden rice? To give rice more vitamin A? Or to do something that people could say, oh this actually helps people?

Gregory Gause: Right.

Jonathan C.: Instead it's ... You know, bovine growth hormone. First applied not to make cows happier, but to increase yields. And who benefited? The larger farmer, larger, corporate farmers.

Gregory Gause: That's the thing that people express real concern about. That the motives will not be improving the human condition, but something else like-

Jonathan C.: Improving the profit of one corporation.

Gregory Gause: Right.

Jonathan C.: And setting down a monopoly on it.

Gregory Gause: Right.

Gregory Gause: Exactly.

Justin Bullock: Makes sense given that's kind of the incentive structure.

Gregory Gause: Well, and these are patentable innovations, right? If you patent a particular gene sequence, is that ... Can you get a patent on a gene sequence?

Gregory Gause: You know, I'm not an expert on patent law.

Gregory Gause: Yeah.

Gregory Gause: But my recollection is that the corn-

Gregory Gause: The Monsanto corn, yeah.

Gregory Gause: Is patented.

Gregory Gause: Is patented.

Gregory Gause: Yeah.

Jonathan C.: You obviously need to get somebody from the Texas A&M law school, which specializes in like eight-

Gregory Gause: They have a lot of expertise.

Jonathan C.: You need to have a roadshow up there, and after that-

Justin Bullock: Future guests, future guests.

Speaker 7: [inaudible 00:42:27].

Gregory Gause: Who was that?

Speaker 7: I think the current dean belongs to and specializes in-

Gregory Gause: Yeah, I think that's right. Yeah.

Jonathan C.: Yeah. But, there's also, you have a lot of ag extension services working on this. And there have been talk about having some ... Particularly in the third world, creating, if not open source software, but open access to these modifications.

Gregory Gause: Case modifications.

Jonathan C.: Right.

Gregory Gause: I mean, one of Texas A&M's most famous researchers was Norman Borlaug.

Gregory Gause: True.

Gregory Gause: Who, I guess you could say, genetically modified crops.

Jonathan C.: Yeah, he did.

Gregory Gause: Not through CRISPR technology-

Jonathan C.: The traditional...

Gregory Gause: Through the traditional hybridization, and was the father of the green revolution.

Gregory Gause: Yeah.

Gregory Gause: And our Borlaug Institute bears his name and-

Gregory Gause: Just to be clear about this, Borlaug has never expressed any interest in, or support for a business model that would call for-

Gregory Gause: Gene editing of fruit crops for ... You know what I mean? There is no business model right now. That would entice a company to invest in the technology. All the investments in technology that are being done right now are being done by the federal government, through universities. And, as I said, nonprofits like the Gates Foundation.

Gregory Gause: But, except for the fact that Monsanto did do some of this. But was that just through hybridization that they created the corn and soy beans?

Gregory Gause: You know, that's good question.

Jonathan C.: I believe it was through genetic modification.

Gregory Gause: I think so.

Jonathan C.: It was through GMOs.

Gregory Gause: Okay.

Jonathan C.: But I'm-

Gregory Gause: It's not a question of whether you can do it, it's a question of whether there's a business model that will return your investment.

Jonathan C.: Right.

Gregory Gause: Well Monsanto found a business model that returned its investment.

Jonathan C.: But-

Gregory Gause: We don't know, I don't know that they've-

Jonathan C.: And by the way, historically, there has been a major federal role for getting rid of dread diseases.

Gregory Gause: Of course.

Jonathan C.: For getting rid of [inaudible 00:44:33], the boll weevil. We've had campaigns against the boll weevil for generations.

Gregory Gause: Yes.

Jonathan C.: And one of the questions to ask is, how do these previous efforts fail? How will this be different?

Gregory Gause: Right.

Gregory Gause: Right.

Justin Bullock: Lot of good questions.

Jonathan C.: If you ... We're historians, we ask the tough questions. We can't answer them, but-

Gregory Gause: In 50 years, perhaps.

Gregory Gause: You'll be able to answer them.

Jonathan C.: Now let me ask, have you asked any philosophers about gene drive for getting rid of nasty critters?

Gregory Gause: Yes, we have one of them, a member of our team is a ... She calls herself a medical ethicist, but she's a philosopher. She was part of the National Academy of Science panel that wrote the gene drive report that was issued about three years ago.

Gregory Gause: She's at the University of Texas Medical Center in Dallas. She's a member of our team, and she's doing many of the interviews that we're conducting right now. The short answer is yes.

Gregory Gause: One of the challenges for us is we're trying to deal with this in empirical ways, you know? And philosophers, not unlike historians, have a lot of trouble dealing with data.

Gregory Gause: Well I would disagree. I would disagree. It's just a different kind of data.

Gregory Gause: Yeah. I'll give you that, Greg.

Gregory Gause: Government documents and texts are data in the same way that large end surveys are data.

Jonathan C.: Yeah, thoughts. And philosophers are trained to approach the questions rigorously. And analytically. And ask questions that others don't ask. And-

Gregory Gause: No, the only difference is you ask questions that can't be answered. We like to ask questions that can be answered.

Jonathan C.: Yeah.

Gregory Gause: We like to phrase our questions in ways that we know that we already have the data to answer.

Justin Bullock: That's a good empiricist right there.

Jonathan C.: And if you're really good you phrase the questions in ways to which you already know the answer that you want.

Gregory Gause: Of course, of course.

Justin Bullock: You find the answer and then you then find the question.

Gregory Gause: Yeah, of course.

Gregory Gause: I take great exception to that. We don't know the answer to any of these questions.

Gregory Gause: No, exactly. What will the answer be, though? What will, at least in a preliminary way, your findings be? What will they report? Not exactly, but what kinds of findings will you report.

Gregory Gause: Well, we have a couple of different avenues that we're working on. One is we want to be able to make some recommendations to the regulatory agencies about directions they should go, how they should divide the labor, where the public concern would be greatest or least. The second is to, particularly for the USDA. The USDA is very cognizant of all the mistakes they made around GMOs. They did everything wrong. But they don't know exactly what some of the right things would be. And they want some guidance on how to handle these issues, in the face of whatever the public and stake holder opinion happens to be. Right?

Gregory Gause: We don't know, for example, that people are seeing gene editing in the same light as GMOs.

Gregory Gause: Right.

Gregory Gause: You think it's a good analogy, but we don't know for sure.

Jonathan C.: But it's different.

Gregory Gause: It's different, right.

Gregory Gause: I know we're getting toward the end, but we've been talking about genetically modified organisms and gene editing.

Gregory Gause: Yeah.

Gregory Gause: Can we get a simple explanation for simple people, like me, as to what the difference is between a GMO and a gene edited entity?

Gregory Gause: I'm not sure [inaudible 00:48:18] any difference. Okay, I think we use them interchangeably. I think, Jonathan had-

Jonathan C.: Are you adding outside genes?

Gregory Gause: Are you adding an outside gene or are you just changing an existing gene? Or turning a gene off?

Gregory Gause: You can turn a gene off?

Gregory Gause: Yeah.

Jonathan C.: Yeah.

Gregory Gause: And that would be the genetic modification?

Gregory Gause: Yes.

Gregory Gause: Whereas a GMO is actually splicing in a gene-

Gregory Gause: Well, they can be splicing of genes, but it doesn't necessarily mean they're bringing a gene from a different plant or different animal, a different critter, right?

Gregory Gause: Okay.

Gregory Gause: Which you can do with CRISPR.

Gregory Gause: Right.

Jonathan C.: And again, what CRISPR does is allow ... And its improved versions. Allow you to be a lot more precise.

Gregory Gause: Very precise.

Jonathan C.: Although there's still, from what I've seen of some of the earlier research, if I'm interpreting right, there's still unintended errors. It's not as precise as it wants to be. But I was looking at the 2018 CRISPR and the 2020 CRISPR is going to be really that much better.

Gregory Gause: Yeah.

Justin Bullock: Part of it, my understanding is, is you can edit specific genes, but it's not always clear all the ways in which that gene interacts with other genes.

Jonathan C.: Sure.

Justin Bullock: Even as we get more specific in the gene that we can edit, once we edit that gene it's not entirely clear all the impacts that gene has on-

Gregory Gause: Yeah, genetics are very complicated.

Jonathan C.: Yeah.

Gregory Gause: And the idea that you can just take a gene from something and put it in and just have one effect, give something a single trait and nothing else...

Justin Bullock: Doesn't seem to be true.

Gregory Gause: We don't know whether that's true, or-

Jonathan C.: Seems to be false.

Gregory Gause: Yeah.

Gregory Gause: Yeah.

Gregory Gause: More often than we think.

Jonathan C.: And again, some of these challenges, you only see these effects at scale.

Justin Bullock: Yeah.

Gregory Gause: That's right.

Jonathan C.: But something that will be very useful, when you introduce this monitoring of baseline before and after. Trying to make sure that you know what was happening before and know what was happening afterwards, so you can see what was going on.

Justin Bullock: This was some of the controversy, to bring it back to the human studies, with the editing of the twins in China, was that the edit made to make the twins more resistant to HIV, the concern was what are the other consequences, right? Does it also shorten their lifespan, which was one of the claims.

Justin Bullock: The issue wasn't with, hey it's great that these twins are resistant to HIV, that's a good thing, maybe. But, it's, we don't know enough about the human genome to know exactly what all the unintended consequences might be.

Gregory Gause: Right.

Jonathan C.: It was very inspiring to see the universal reaction among geneticists.

Gregory Gause: It was.

Jonathan C.: Which was just absolute horror.

Justin Bullock: Yeah.

Jonathan C.: You know, you did what?

Justin Bullock: Yeah.

Jonathan C.: And you didn't tell anybody, you didn't authorize-

Gregory Gause: And there's a lot of skepticism about whether it actually happened.

Jonathan C.: It happened, yeah.

Gregory Gause: There's the fraud

Gregory Gause: Yeah, fraud.

Jonathan C.: Fraud.

Justin Bullock: Fraud showing back up.

Jonathan C.: Which is why the Russian case is interesting.

Gregory Gause: Yeah.

Jonathan C.: Because here's a guy saying, look, I'm not saying I'm going to do this, I'm saying we need to be thinking about doing this. And that's a lot of what we need to be talking about. Well, what are some of these consequences? What are some of these issues? Because genetic editing is going to be playing a much more prominent role in upcoming decades, worldwide.

Gregory Gause: Like it or not.

Jonathan C.: Like it or not.

Gregory Gause: Right. Kent, in the interviews that you've been conducting, you and your team, do you find gradations in how worried people are? In other words, are they more worried about gene modification in animals than in plants? I mean, is it-

Gregory Gause: Doesn't seem to be any difference there.

Gregory Gause: Yeah.

Gregory Gause: This is a very challenging area to do research in, because nobody knows anything about it.

Gregory Gause: Right.

Gregory Gause: You can ask me people about it, but how do you ask somebody a question about, what do you think about gene editing? Or gene drive, when-

Jonathan C.: I saw that movie with him.

Gregory Gause: That's right. But nobody knows what it is.

Gregory Gause: Yeah.

Gregory Gause: Unless you have some way of describing it, people don't know how to react.

Gregory Gause: Yeah.

Jonathan C.: And then-

Gregory Gause: They say, I don't know.

Jonathan C.: Yeah.

Justin Bullock: This is the real general problem with emerging technologies, right?

Gregory Gause: Exactly.

Justin Bullock: We've done ... Jonathan and I were on a panel talking about AI. Which some of the things that I've been studying on, and because it's so new people don't really understand how it works and what the consequences are. It's just this big, scary, amorphous thing, that people don't really know what to do with.

Gregory Gause: That's right.

Jonathan C.: And yet, there's some things that go, wouldn't you like to be rid of pigweed or Rift Valley?

Gregory Gause: Yeah, yeah.

Gregory Gause: That's right. Yeah.

Justin Bullock: All right, I think we're getting close to our time mark. We have a couple of people in the audience. We're going to give them an opportunity to ask us any questions.

Speaker 7: You mentioned the concern about Rift Valley fever, even though until fairly recently it's been mainly isolated in Africa, there's a possibility it could come to Texas.

Gregory Gause: Right.

Speaker 7: Versus if somebody develops a genetically modified organism, or genetically edited, whatever you want to call it. That also could travel around the world.

Gregory Gause: Yeah.

Speaker 7: You also mentioned that congress needs to regulate this, but I'm not sure that would enough. If something were allowed in Canada, but not the US, it would [inaudible 00:53:45], that sort of thing.

Jonathan C.: Right.

Gregory Gause: Yeah.

Speaker 7: And unless US is willing to threaten to annihilate Canada, nothing would happen. It would just happen, right?

Gregory Gause: Well with the current administration, threatening to annihilate Canada might in fact happen.

Speaker 7: Absolutely.

Gregory Gause: Yeah.

Gregory Gause: Or in this case, Mexico, which is-

Jonathan C.: Or both.

Gregory Gause: Well, once we-

Justin Bullock: Or both.

Gregory Gause: Once we build the wall, all those problems in Mexico will just stay in Mexico.

Speaker 7: Is it being discussed internationally?

Gregory Gause: Yes, a lot of-

Speaker 7: And if there has, is the United Nations willing to go to war to enforce this, and that kind of thing? The last time I remember nations voluntarily all getting on board with this sort of thing was when the ozone layer crisis with fluorocarbons.

Gregory Gause: Yeah.

Speaker 7: And everybody did get on board, but it was a very easy to explain problem. It was a very simple, straight forward fix.

Gregory Gause: That's right.

Speaker 7: This is a lot more complicated and it's a lot more different opinions.

Justin Bullock: The question was, is there an international cooperation effort, given that edits made in one country, or modifications made in one country, could have spill over effects into other countries?

Gregory Gause: And are there international avenues for regulation?

Gregory Gause: There are a couple of international organizations that have promulgated standards for doing research on these issues, across countries. They have no legal authority. Would the UN go to ... How did you put it? Would the UN go to war?

Justin Bullock: Go to war. Yeah.

Gregory Gause: No.

Speaker 7: [crosstalk 00:55:15].

Gregory Gause: And my recollection is, I could be wrong about this, the US is not a signatory to any of those international agreements on gene editing. There's a lot of concern about that.

Gregory Gause: Now, our research project, which is focused mainly on Texas, is talking to people in Mexico about this. Stakeholders in Mexico, to see, what do you think about this? Are you worried about this? How are you going to deal with these kinds of issues?

Gregory Gause: I don't have any answers for you on that, yet. But we are accounting for that.

Jonathan C.: Right.

Gregory Gause: At least that piece of it. Specifically with respect to pigweed, because if we modify genes of pigweed to try to wipe out pigweed, it's impossible to imagine that we could contain it to the Rio Grande.

Jonathan C.: Monsanto had that problem, despite its claims, that it's genetically modified soy beans.

Gregory Gause: That's right.

Jonathan C.: But if you really want to be scared about international gene trend, it would be the weaponization. It doesn't have to be a gene drive, but bad guys willingly trying to spread Rift Valley Fever or some other form of agro-economic warfare.

Gregory Gause: Yeah.

Justin Bullock: And another example of this kind of pulling out, too, is in AI, in autonomous intelligence systems, where there's not a strong, international enforcement mechanism, for example, to keep countries from making autonomous weapons.

Justin Bullock: The strategies that then people take are through professional norms and general technical standard agreements. Because you don't have these kind of sticks, these kind of enforcement mechanisms that we would hope we would have.

Gregory Gause: But you have to assume that drones ... Pretty soon drones are going to be autonomous weapons, right?

Justin Bullock: They already are.

Gregory Gause: Yeah.

Justin Bullock: I mean, there already is the capacity of drones autonomously finding a target and firing.

Gregory Gause: And firing.

Justin Bullock: The only safeguard in right now, that's practiced in the US, to my knowledge, is you have someone that actually presses the button to pull the trigger.

Gregory Gause: Right, right.

Justin Bullock: But now drones can do it through video recognition, and facial recognition. Can go, find a target, lock onto them, and then the only piece in there right now is a human saying, yep, that's them, fire.

Gregory Gause: Right.

Justin Bullock: But the technology is there already.

Gregory Gause: Which is the easiest thing to replace.

Justin Bullock: Yes, yeah. It could be replaced now.

Gregory Gause: Right.

Justin Bullock: It's just norms and standards are what's keeping us from doing away with the human in the loop at that piece.

Gregory Gause: Well, on that happy note.

Justin Bullock: We will be back with you in a week. If you have an opportunity come out and join us at Downtown Uncorked. Next Tuesday, December 10th at five PM.

Gregory Gause: Five PM start for our final podcast of the semester, and of the calendar year.

Justin Bullock: And we will be shifting back ... Well we kind of ended on some international affairs issues.

Gregory Gause: Right.

Justin Bullock: But we will jump back into a full fledged international affairs conversation, talking about Ukraine and why it's relevant to US foreign policy.

Kent Portney: With Ambassador Larry Napper.

Justin Bullock: With Ambassador Larry Napper.

Gregory Gause: Exactly.

Justin Bullock: Kent, Jonathan, thank you so much for taking the time and being with us.

Kent Portney: Thank you.

Jonathan C.: Thank you.

Justin Bullock: It's always a pleasure, and we'll do it again soon.

Gregory Gause: Okay, thank you.

Justin Bullock: Thank you.