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Interviewee: Glenn Stone
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[00:00]

Todd Kuiken:: So I'm here with Professor Glenn Stone from Washington University. It's January 24, 2017, and we're here for an interview for the Archive on Agricultural Genetic Engineering and Society. So first, thank you for agreeing to do this with us.

Glenn Stone: My pleasure.

[00:19]

TK: So first we're going to kind of do some background questions and career questions. So could you tell us your name, where you're from and what your role is there?

GS: My name is Glenn Stone. I publish under Glenn Davis Stone. I am a professor of Anthropology and Environmental Studies at Washington University which is in St. Louis, not Seattle or Pullman. And I teach and do research there.

[00;49]

TK: So what did you want to be when you were a kid or what did you think you wanted to be when you grow up or what do you want to be when you grow up?

GS: I guess when I was a kid just the idea of being a grown up was so far beyond what I could get my head around I wasn't really thinking about it in very concrete terms. I guess I started thinking about being some sort of a scholar or intellectual in college. My father was a scholar and a writer and it seemed I liked the college environments. I liked college atmosphere. I liked intellectual pursuits. I didn't really have a field that I wanted to pursue, and I ended up as being an anthropology major because I had tried everything else. And that was about all that was left.

And as an anthropology major I got to the summer of my junior year and I couldn't get a job and didn't really know what else to do, and the university I was at, which was Northwestern, had a famous archeological field school which was running in a small town in rural Illinois. And so I went to be an archeologist for the summer and absolutely fell in

love with it and came back knowing that I wanted to be an archeologist. So that led me from being – and archeology in the U.S. is a subfield of anthropology so this is somebody who already was majoring in anthropology deciding that he wanted to pursue anthropology professionally.

[02:19]

TK: Could you maybe, for people who might not know maybe explain a little bit of the similarities and difference between archeology and anthropology?

GS: Yeah, the way…

TK: You know archeology through Indiana Jones.

GS: Yeah. The way it works in the U.S., anthropology is a field of four different sub disciplines. So there's linguistic anthropology which studies variation in language. There's physical anthropology which studies variation in the human bodies and evolution and primates. There is archeology which basically studies cultures of the past usually using material remains. And there's cultural anthropology which studies patterns and variations among human cultures. So the basic difference is ancient people versus modern people, versus living people.

[03:10]

TK: So could you maybe talk a little bit more of how you sort of wound up getting into this field of study. Were there, you know, certain people who influenced you beyond just the university as a whole to kind of point you in that direction?

GS: Well I got interested in agriculture all the way back when I was at the archeological field school as an undergrad because the site that I was put on that made me fall in love with, you know, with archeology was a site where they were investigating early corn agriculture. And so we were looking at people who were basically hunter gatherers who were just starting to grow primitive corn, you know, in the early days. And we were out in the middle of a modern day corn field with modern industrial corn being farmed with tractors and pesticides and fertilizer and so on, and they cleared a little block where the archeological site was.

So I was intrigued by just the difference in what corn agriculture was like thinking about how very different people's lives would have been over 2,000 years ago starting to grow this primitive corn just as part of their hunting and gathering subsistence and then looking around at modern day farmers and a $50,000 tractor driving around, and I became very

interested in the idea of long-term change in agriculture. And this basically led to an overarching interest in the cultural situations within which agricultural change occurs or the agricultural situations within which culture changes.

In terms of the people there, the whole foundation that was running the archeological project was run by an archeologist named Stuart Struever who had written some very interesting things about agricultural change and I ended up working for him after college running excavations for him. So he was a major – had a major impact on me. Then I went to graduate school thinking I wanted to be an archeologist and study ancient agriculture, but began a collaboration with Robert Netting who was a cultural anthropologist. And Bob Netting was very well known for his research on small farmers and on the organization of small holder farming and on technology and on how they change through time.

And we found that we hit it off and I had certain analytic and computer skills that he found very useful, so we started re-analyzing a lot of his data that he'd collected among some African cultivators back in the 1960's and eventually decided that we would work together. So I switched my research interest from ancient southwestern agriculture to contemporary African small holders. So it was quite a shift. I was still concerned with how agriculture changes through time and how it's constructed socially and how it works. So I worked with him a lot and so he was an enormous influence on me not only because he brought me to the site but because he influenced my thinking a lot, and we continued to collaborate for – well for 14 years before he passed away.

[06:27]

TK: So can you talk a little bit about that process and how that led you or got you interested in genetic engineering as a technology for agriculture and studying that?

GS: Yeah. So after I did field work I found that the niche that I was carving out for myself had to do with agricultural change. And at the time, in the early part of my career I was still classified as an archeologist. So I finished my graduate work, I joined the faculty at Columbia in New York as an archeologist, but I was very interested in agricultural change in general and I was still writing about contemporary agriculturalists even though my [academic] ethnic identity was archeologist.

So in 1994 I was in my apartment on Broadway and 113th on the Upper West Side of New York writing about agricultural change and decided to take a break and go down to the store and buy a snack and there was a sign there that said McGregor's Flavor Saver genetically modified tomatoes and I had no clue what that was all about.

Now there had been discussion about this in the press and in the academic literature for awhile but I was studying farmers in situations that some people call paleotechnic or very simple agricultural technologies and this seemed to be something taking place off in the world of biology, genetic modification, and if I had read anything about it it had gone in one ear and out the other. I thought it had nothing to do with me.

But suddenly here was food in a market in New York that was called genetically modified which struck me as intriguing. And like a good scientist I bought a genetically modified tomato and a conventional tomato as my counter factual and brought them back to my apartment and sliced them up and put a little salt and mayo on them and thought they tasted pretty similar and thought huh, I didn't really know what to do with that information. But it certainly stuck in the back of my mind.

So then what happened was, if I can give you a 30-second history of the spread of GM crops, very soon after that GM technologies were put into various big commodity crops that were being adopted by farmers in the U.S. and they also began to move into western Europe. And there was a massive – there was as large scale reaction against it. I think the technical term was the shit hit the fan. And suddenly the biotech industry, at least in my view of this, found themselves in need of a more compelling narrative about why these technologies are good because the technologies had become established in the U.S. without really a compelling narrative.

It was a new technology. They got some insect resistance. They make it easier to use herbicides and farmers had adopted it. It had been relatively low level of controversy.

Now we were in Europe and there was a large scale of controversy and the biotech industry, especially Monsanto, were really taken aback. I think and they realized we need a more compelling narrative about what these technologies are and why people shouldn't be resisting them. And so it was in the late 90's, like 98 and especially 99 and 2000 we started to find the narrative emerging that these technologies are for the small holders; these are for people in developing world.

These are going to help feed people and better nourish people in developing countries. They're going to help small holders in the Third World basically. And so at the same time that this narrative was coming forth from the biotech industry and from some of their public relations arms like the Council for Bio-Tech Information, there was a movement against that from people who were arguing against GMO's and who were arguing - they claimed - for the small holders in the global south.

And so basically there was a big fight going on that had everything to do with farmers and eaters in the global south. And on one side you had industry representatives whose interests were to produce and sell products. On the other side you basically had NGO's whose interests were to try to impose their view of the world and get funding and so on, talking about small holders in the global south. Neither one of those sides actually studied small holders in the global south. I did.

And so that's really what led me to start thinking in 1999 it would really, you know, if there's some way that I could shift my research program to actually look at these small holders that are being discussed so intensely as the future beneficiaries of these crops. So it was that debate and the lack of voices in it from people who actually studied small holders that led me to start rethinking. I can talk more about that if you want.

[11:46]

TK: You know you've answered a lot of these questions so now I'm trying to reorient myself. And so Fred you can jump in anytime if you want.

Fred Gould: Yeah, so we would like to hear more about your experience in terms of working with these farmers and really understanding how they integrated genetically engineered cotton I guess for the most part and how they viewed what it was. What did they, you know, we all talk about what is genetically engineered versus conventional. They've found that we had different ways of understanding it or did they?

GS: Okay, let me – good question. Let me sort of get myself there into the field first.

FG: Yeah. Go ahead.

GS: So I was – it was very difficult to figure out how to intervene in this whole realm as an anthropologist. Social scientists had not been, with a few minor exceptions, had not really been involved in this issue very much, and I thought the first thing that would really be helpful here would be at least some background in the technology so we'll know what's going on technologically and also know something about the people who are producing it to know where they're coming from.

So I wrote a grant proposal in 2000 or I guess I wrote it in 1999, to the National Science Foundation for what's called a Scholar's Methodological Training Grant. Now here's how that works. Cultural anthropology is an interesting field that has got on one hand some very scientific, positivist, empirical, theory driven, statistical sorts of research that goes on. On the other side of it some of it is not at all positivist, is very almost impressionistic. And

so it's got this very wide spectrum. And the cultural anthro program at the National Science Foundation likes to promote the more scientific sorts of research.

And so they've got a special program there that allows cultural anthropologists to get training that will help them be better anthropologists on the more scientific end of things. And so for instance sometimes these awards go to people who want to learn how to use GIS so that rather than just going out into the field, you know, physically you can study patterns through the computer or things like that.

So I applied to them and said look, I don't want to learn GIS; I want to go work in a biotech lab where they're actually making – working on crops that might benefit small holders and see how you make it. And so it will be like an intensive internship, a boot camp for me, but also spent time with these people to see how they work and learn about it.

And so that was the grant that I got and I worked at the Donald Danforth Plant Science Center with encouragement from people like Bill Danforth who was the big driver of this who was a real inspirational figure for me, and I worked in the lab of Claude Fauquet who was a French virologist who was working on genetically modified cassava. And I particularly worked with Nigel Taylor who was a specialist in tissue culture but who was a real leader in working on these crops that are probably the most potentially beneficial to farmers in the global south.

And so they were my mentors and we spent a lot of time talking about how to run gels and how to use agro and that sort of stuff, but also spent a lot of time talking about what are you doing? I mean how are you going at it? How do you think about this? How do you interact with other scholars? How do you interact with Monsanto? How do you decide what to work on, all those sorts of things. So I didn't write on that because it wasn't really designed to be like a sociology of them, and also they were my friends at this point. I didn't really want to write about them, but I learned a hell of a lot from them.

That same grant also paid for me to go to a couple of different places in developing countries where it struck me that there were important stories breaking. That grant and another grant I got from the Wenner-Gren Foundation. I said I wanted to go to three different countries in the global south that are all at different stages of moving into GM crops. One was South Africa which already had GM crops in the field. They were considering others, but they already had GMOA's out there. One was India which was moving toward a GM crop. It would have been Bt cotton. It wasn't approved yet but it was in testing and it looked like it probably would be approved within a few years.

And the third was Nigeria which had a CGIAR center in it but it didn't have any crops that were particularly close to release, but it looked like they might be at least moving in that direction. So I wanted to visit all three of those countries to try to get my head around what's – how this whole GM agricultural thing is developing at least in that sample of countries.

Before I left I decided to scratch Nigeria off the list because it was too far away from having GM crops and I already worked in Nigeria before and it was just going to be too much. I did some research in South Africa, but I found that India was just where it was happening, absolutely fascinating in terms of just the sheer number of farmers - the potential demand for Bt cotton was just huge. Hundreds of millions of farmers, cotton farmers, all having problems with the lepidopterans that the Bt cotton is designed to…

[17:35]

FG: What year was this?

GS: This was 2000 which was two years after India had gotten in the headlines in the U.S. even because of a farmer suicide epidemic. And so India was also a lively place because it had such a very organized and media savvy resistance movement, some very sophisticated NGO's that had adopted an anti-GMO stance. And it was lively because of the press there was just wonderful. I mean really lively. It's a huge educated middle class in India and they have lots of newspapers that stake out very distinctive positions.

And so – and also it was an interesting place to me because I had my suspicions that most of the GM crops that were being deployed in various places in the world probably didn't have that much promise to help small holders in the global south. So I was interested in which ones do have the most promise and this struck me as a great candidate. These farmers grow a lot of cotton, they're really having a tough time, and a lot of it – it's not just because of the insects, but the insects obviously are a central part of it.

And this stuff [cotton] has got this Bt that seems to be pretty effective against a lot of lepidopterans. And so for all of those reasons it seemed to me that the question of Bt cotton in India was a great thing to focus on. So I switched my research focus – I had never worked in India before; I took a lot of the African research and just put it on the back burner thinking I'll get back to it one of these days, and it now looks like I never will.

[laughter]

GS: But I took up India as a research focus. So in terms of the question about what the farmers made of it…

[19:46]

FG: So how did you embed yourself in there? Was the language at all a barrier or how did you become the embedded anthropologist? What's the word you used?

GS: Yeah, well the way we normally work in anthropology and what we take pride in is doing an ethnography which normally means that unlike other social scientists we actually go and live in the community and we pride ourselves and really take pride in really learning the language, learning the local ways and so on and becoming in our own weird way a part of the community, obviously never a typical member, but and most anthropologists do that earlier in their careers. And we had done that – what, when I did my fieldwork in Nigeria with the group called the Kofyars with my wife and for awhile with our mentor, Robert Netting. And we did that. We lived in a little village and learned Kofyar and did all of that.

The fact of the matter is when you get older in your career and you've got – you're a professor and you've got kids and so on and so forth it gets to be harder and harder to do that so most of us find other ways of doing ethnography. That's one of the reasons that people learn to be GIS specialists is they can't go and spend a year living in the village anymore.

So for me the way I worked it out was I began to do back and forth ethnography. So I had people there in Warangal district who helped me with logistics and gave me a place to stay and helped me with connections, and I would go there and I would spend a summer and I would go back during Christmas break, you know, for three weeks, and I'd go back the next summer. So I never actually lived there for more than oh probably six weeks at a time, but I went back over and over again. And so in-between 2000 and up till now I probably spent about 65 weeks total there and I've also sent students back quite a bit.

I'm ashamed to say that for language, language was a barrier for me. I was pretty good with languages when I was younger, not great, but I could hold my own, and as I've gotten to be a little bit older I've lost some of that ability. So I really, really wanted to learn the local language which is Telugu there. And I tried. And I was picking it up very slowly and finally I said okay, let's do this right and I spent the money on this set of tapes and everything and I spent hours and hours sitting around my living room repeating the Telugu and I had at least made some progress.

And I showed up the next summer and I trotted out my Telugu and they all looked at me like I was speaking French. And I said what's the problem? And they said you're speaking like Andhra Telugu and we could barely understand it. So the tapes were teaching the sort of Telugu of the dominant group called the Andhra Telugu and they – I was in Telangana they actually speak a different dialect so it not only sounded wrong to them; it also sounded sort of pompous and so on and so I basically wasted my time.

So at that point I said okay, I'm going to be working with translators, period. I'm just not going to be able to get around that. But it's important to learn as much vocabulary as you can because it helps you to work with translators, and there's an art to working with translators so I've got a lot of experience at that now. And it's got some disadvantages but it has a few advantages. The disadvantage is you're not directly speaking and you have to work obviously through the translator, but one advantage is you take great notes 'cause in the translation time rather than taking the super sketchy notes that you sometimes take when you're speaking the local language yourself. There's down time while it's going back and forth.

[23:41]

TK: Could you maybe talk a little more – I mean and you mentioned that you have sort of industry on one side and NGO's on the other side, both sort of simultaneously suggesting that they were speaking in essence for the farmer. Could you talk about the sort of the questions that you went in there with in terms of being able to actually pull out what that actual farmer actually wanted or didn't want and maybe some, if anything, sort of shocked you or the things that sort of doubled down on what you already sort of thought going in there in terms of what you were hearing from industry in the NGO's versus what the actual community was dealing with as you were sort of interacting and living with them?

GS: Yeah. I got very interested from the very first week I was talking with farmers in Andhra Pradesh. I got very interested in the whole issue of farmer knowledge which turned out to be very central to what was happening with GMO's there and also just central in terms of understanding farmers in general. But one of the things that really struck me, I started off wanting to ask questions like okay, here comes an insect resistant cotton, what are your insect problems like, how are you handling them otherwise? What might you do without this, you know, questions that are directly linked to the Bt cotton.

But I found out immediately that with cotton, not with other crops it turned out, but with cotton there was a great lack of knowledge which was quite a shock to me because like most anthropologists who work on indigenous agriculture I had developed a real healthy respect for indigenous knowledge, not just on the part of the individual farmer but on the part of local systems who often times had wisdom sort of built into them. And I had written

some about this and my mentor, Bob Netting, had written a lot about it. And the farmers that I studied in Nigeria, the Kofyar, most of whom were illiterate, knew a lot about the seeds they were planting and could talk very intelligently about what seeds to use in which situations.

So I get to Andhra Pradesh and these farmers I found were buying cotton brands on the market that they knew oftentimes nothing about whatsoever and I immediately saw that there was as real, you know, I called it a faddism going on where farmers, rather than saying which seeds will mature, you know, in the right time frame and which seeds will respond well to my sorts of soils and respond well to the sort of irrigation resources I've got and so on and so forth. They were simply saying what's the good seed this year? What's everybody buying this year? What do the vendors think that I should buy?

And so it was a jarring realization for me to go from people like the Kofyar with their knowledge of seeds to these folks who were clearly bereft of information about the seeds they were planting. So to me that struck me – that seemed to be very important not only in terms of the specific questions about Bt cotton and what sort of impact is it going to make here, but I also saw it as important just in terms of the larger issue of farmer sustainability and farmer knowledge and so on.

So the knowledge thing struck me immediately as important, and a few years later when I wrote a proposal to the National Science Foundation for a big grant to fund multiple years of research, the title of the – I think the title of the proposal was "The Political Ecology of Information Among Cotton Farmers" ["Biotechnology and the Political Ecology of Information in Andhra Pradesh"]. So it really had to do with how they figure things out and what they know and what they don't know and how a new technology coming in can impact that whole process. So that was very important.

While we were doing research with these farmers we also looked at a lot of other things that were just sort of obvious to look at while we were there. We looked at some of the farm economics, we collected information about yields. We collected some information about overall farm budgets but didn't do that really comprehensively because it's actually harder to do than a lot of people would have you believe.

And the other thing that we wanted to do that was somewhat unique was we wanted to look at these farmers over a long period of time because there is a tendency for people to be – many social scientists to be rewarded for going into a place where there's a technology that people are interested in like Bt cotton and doing a short-term study that shows that oh the Bt cotton has had the following effect, it's raised yields by 14 percent; it's

lowered yields by 12 percent, and then moving on to something else. And that finding is left out there as if it were really significant.

I'm not convinced that the one-year bump in yields really means much at all because I'm very – we're all interested in sustainability and so if we agree that agricultural sustainability is important why are we focused on one-year returns? What really matters is what's going to happen after two years or four years or 10 years? And this is especially important with these Indian farmers because the reason that they were – the reason they needed Bt cotton so badly was because of the last round of technology they had adopted which was herbicide – which was insecticide intensive seeds.

So they had – the farmers in our area had started going big time into planting hybrid cotton seeds in the early and mid 90's and they had been – had to spray a lot of insecticides on the cotton which they did, and the insecticide started to lose effectiveness and so they had to move on to another insecticide and then another insecticide. So you could have done a study of any one of those insecticides when they were new and you could have found well this stuff was a huge success. It's raised their yields; it's mitigated their insect problems, great stuff.

But again that's fairly meaningless. What you need to do is take a step back and say is this insecticide really a success for these farmers or is it just one notch in the pesticide treadmill that's grinding them into dust? And so we didn't want to just look at the how does the Bt cotton work the first year or the second year. We wanted to look at what the trends were going to be through time. So I guess if I had to pinpoint what the special entrees were in our work the first part had to do with a real interest in indigenous knowledge and the second part had to do with look at dynamics through time.

[30:38]

TK: So we're going to jump around a little bit.

FG: Can I bring you back…

GS: Yeah.

FG: …to this question of how did your farmers who were planting the Bt cotton see those seeds and the technology? What was their way of describing it or did they even describe it? Here, you know, we would consider, okay a gene from a bacterium was put into this and it produced a protein. That was not their language I assume. What was their language or did they have something?

GS: I think – okay in the first place their views of the Bt cotton were definitely changing through time. When we first started – when we were first interviewing farmers in 2002 which was the first year that Bt cotton was actually on the market, oftentimes farmers didn't know what we were talking about. And so in terms of the actual language it's – I mean the word in Telugu for cotton is pathi and they would just say Bt and so the translator would say, you know, Bt pathi. And oftentimes the farmers didn't know what he was talking about in 2002.

Sometimes we would then say have you heard of terminator pathi, using the English word terminator, and sometimes they'd heard of that. And that was because of an anti-GMO group based in Karnataka which is the state down to the south, very media savvy, had organized marches a few years before, marches against Monsanto's terminator cotton. This was a reference to a cotton gene use protection technology that actually was developed by Delta Pine and Land, and Monsanto had been trying to buy them; they failed at the time.

But it was one of these stories that got people's attention. If you said – I mean if you said they're genetically modified crops out there, what do you think about that, a lot of people wouldn't really have an opinion. If you said there are these terminator seeds out there that make it so the farmers can't replant them, a lot of people found that very agitating. And so these media savvy groups in Karnataka especially had organized marches against terminator cotton, and some of the farmers had heard of that.

So in the early days very few farmers in our villages in Andhra Pradesh were adopting the cotton and many of them didn't really know what it was and some had heard of it and they didn't know what to make of it and some just had heard of some sort of a terminator thing. I think that within about two years – we don't have actual data on this. This is just anecdotal. I think the great majority of the farmers had heard of Bt cotton and most of them could even specify the company that made it.

There was a company called Mahyco which was a big cottonseed company there, and if you said to a farmer have you heard of Bt pathi they would say yeah, that's the Mahyco stuff. And I think most of them knew that it produced some sort of insecticide. In terms of their understanding of the genetics I would expect very few to have understood that. Within a few years after that there was a new [transformation] event – a cotton based on a new event came out that had two different Bt genes in it. And they called that Double Bt. And they used the English, Double Bt. And I think their perception of that, maybe some of them thought it had two different Bt genes. I think probably more commonly they thought it just had twice the dose, you know, twice as much of the Bt.

So we're up to about like 2006 or something like that. Within a few years after that a lot of farmers, if you asked them about BT cotton they would say no, we don't plant that anymore. And my doctoral student, Andrew Flachs, who defended a dissertation on the Andhra Pradesh cotton farmers last year. He's done interviews with farmers more recently than I have and he's the one who reported this back to me that not all of them, but a lot of the farmers would say no, I don't – Bt, that's what everybody was talking about before. And nowadays the box – it says Bt on it but it's sort of in the fine print, so I think a lot of farmers have sort of lost sight of that.

FG: Interesting.

GS: Yeah.

[35:35]

TK: So this is one of our sort of standard questions but so government and later university investment in agricultural technology goes back at least some would say to at least sort of the 1840's in the U.S. What have you learned about industry's contribution to agriculture from your work both here in the U.S. but also in other countries?

GS: Well I think the U.S. has really been the world leader in what I would call industrial agriculture by which I mean agriculture based on externally produced inputs, oftentimes in factors. And you're quite right that government funding for this – you said industry funding, right?

TK: Well I mean I think it's starting with government funding in the U.S. even like where we sit now is a land grant...

GS: Right, yes.

TK: …but over time, you know, things have shifted.

GS: Right. So I mean there's been a long history of government funding industrial agriculture, and one of the things that land grants started doing right off the bat was doing fertilizer research because that was the one big industrial input that was already out there. The first industrial input was fertilizer which goes back to the 1840's, first with the guano trade but then they were making early fertilizer by, you know, putting sulfuric acid on phosphate. This is before they were able to fix nitrogen.

So there was a bunch of fertilizer washing around this country by the mid-1800's and one of the major things that the government was funding land grants to do was to do research

on the fertilizer, and part of it was to protect the farmer to sort of see if these claims [the fertilizer manufacturers were making] are accurate and so on and so forth, if the fertilizer manufacturers were doing, were making, but part of it was to benefit fertilizer manufacturers to find out, you know, what works. So that set a pattern that's gone on to be a major pattern in industrial agriculture ever since which is the government subsidizing research that leads to industrial [agricultural] products.

And it wasn't long before a lot of land grants and other government supported offices were actually actively selling the stuff. And some historians have written about this recently, especially in the south like in Alabama where there wasn't that much money to fund land grants 'cause the Federal government didn't actually fund the land grants. It would just give them land that they could sell off and use that to get a land grant college started. Once the land grant college got started you needed the state to support it. And in some of these places like Alabama where they didn't have a lot of money for it the land grant scholars made part of their money by selling fertilizer to farmers.

So from a very early point on, especially in the U.S. you've got publicly funded basic scientists who are not only doing research in order to benefit industrial ag product producers, but actively promoting their products. So I see that as having been a long trend that starts back then and it just has gotten bigger and bigger and it certainly got to be huge in the era of bio-tech. And so there's, you know, there's nothing new about industry like the biotech industry coming onto campuses and saying we want to fund you to do research to help us produce products. It's furthering a trend, but it's greatly enhancing it.

And there's a history to that too that biotech genetic engineering came along just as funding from the Federal government was drying up. Now part of this had to do with the Vietnam War. But there was much less money going, Federal money, going from basic research in universities in the late 60's and early 70's and a lot of universities had grown. There was like these, you know, baby boomers and so on and so forth. And so a lot of them had gotten bigger and so they not only needed money because the Federal government was drying up a little bit, but they needed extra because they'd grown and they had to maintain themselves.

And so right there you have 1972, the first recombinant DNA. And suddenly there is this very research intensive technology and it's being, you know, that industry is starting to develop. So that's why it's a great enhancement of this long-term pattern that we see of industry getting publicly supported science to work for its benefits. And so now, of course, it's extremely common – I'm sure it's particularly common in places like North Carolina

State where a lot of the "basic research" that's going on is partly funded by industry which oftentimes has got rights of first refusal for the intellectual property.

And it's an interesting way of constructing what basic science is because the researchers, of course, can get rewarded by publishing their work in [academic] journals. And they're rewarded by tenure and the status of being an academic scientist and those sorts of things. And some of their work never gets commercialized at all, but at the same time much of the research direction oftentimes if directly influenced by corporate money coming in and a lot of what they come up with does end up, you know, being privatized.

[41:22]

TK: And just to maybe to build on that. So does any of that in terms of the farmer, in terms of the interactions you've had, do they care in essence in sort of that long history and influences positive or negative, however one might look at those? And then maybe to get back to what you were talking about before, you know, are those research endeavors really speaking for those farmers that they are purported to be helping?

GS: So it's an interesting question. I think the issue of do they care is hard to answer because the way the system works it is not oriented towards developing crop technologies to help farmers in the global south. So the things that they should care about are the crops that they don't have. And so they – and the main reason that they don't is because of a whole intersection of interests which it works like this. In order to make a genetically modified crop you have to use many different patented technologies; that's always the case. That includes actual technologies to transform things, gene guns and agrobacterium and so on. It also includes the actual genes and the pieces of DNA and so on and so forth.

So if I am an academic scientist what I want is I want my experiment to work and I am going to use whichever patented technologies will actually make it work, not necessarily ones which are suboptimal, but they would be good for the developing world. Corporations are usually very quick to allow academic scientists to use their patented technologies only for research purposes. And so they'll give them what's called an MTA, material transfer agreement, which basically is a contract that says sure, you can use our genes, but if you develop something and you ever want to do anything with it you've got to come back to us. This is strictly for research.

And so the scientists, what they want, if they want the experiment to work they want to publish it. And so they end up with technologies being developed that are IP encumbered. They are filled with patented genes and they're made with patented technologies that make so that yeah, it worked and it helps them with their career, but in order for that ever

to be put into the field for farmers it has to go back through Bayer and Monsanto or Syngenta or whoever owns those patents.

So that means that the system is set up to work towards crops that can be very profitable. And so if you want to make a crop that actually can help improve agriculture in the developing world or improve nutrition or something like that, you've got a real problem on your hands. You either start from square one using – getting the freedom to operate clearance for all your technologies or you just go ahead and try to get the thing to work and then go and beg the companies to agree to support it.

Golden Rice is the famous example of this. The developers who worked on that were like a lot of molecular biologists, not all that aware of the ramifications of using different technologies. I mean it's usually pretty easy for them to get it, to get the technologies, and so they got this Golden Rice to where it was proof of concept. It wasn't making enough beta carotene to really make a difference in somebody's diet, but it seemed to be working so they were quite optimistic about it.

And then when they tried to take the next step forward and say how can we actually get this into farmers' fields and maybe get it on kids' plates they found out that it was heavily IP encumbered. And they had to get all of these patent clearances. In that particular case it's sort of the exception that proves the rule because that happened in 2000 which was right when the biotech industry was trying to develop this narrative that this is a pro-poor technology. And so Monsanto was very quick to say yeah, we'll give you a patent clearance on that one.

And they then promptly sent out a press release all around the country that a lot of people read it to say that they're basically taking credit for having developed Golden Rice. But that was exception that proved the rule. So the system is not really – because of these patent problems and because of the fact that it takes so many different technologies to actually make a functioning genetically modified crop, the system is really not set up to produce things for those farmers. So do they care about it? They would if they knew what was going on.

[46:20]

TK: So I'm going to shift kind of gears a little bit before I shift gears completely, so over the years of being embedded with different cultures and different farmers, have your views on the technology of genetic engineering changed at all when you sort of started to know?

GS: The view that I had developed after a few years of being involved in this – that's after working in a biotech lab and after spending some time in India there before Bt cotton was

released and for the first few years and so on. The view that I developed was that a lot of these technologies may well have some serious promise for farmers in the developing world. They don't yet. They don't actually offer a lot yet, but they might, and that what we need to do is to cut through the corporate narratives about these crops in general are needed to feed the Third World and say well specifically what crops might actually help farmers and why.

So I wrote an article about that that talked about Golden Rice as something that although I felt it was over hyped I felt that actually had promise, and I said we really need to allow this to see if we can get it working because if it does work it's not going to be IP encumbered; it will not be a hybrid. They'll be able to replant the seeds and it may actually improve nutrition in some very undernourished populations. So I thought that actually had a lot of promise.

I also was very interested in virus resistant and bio-fortified cassava. And rather than just make an argument about how GM crops are needed for the work to feed the Third World, I wanted to say specifically what is it about cassava that would make it a good candidate for genetic modification for small holders? And there are some specific reasons that I thought it would be. Cassava is a great crop for the poor. It is both a subsistence crop and you can sell it so it gives that flexibility. It's really important for small holders.

It is a very forgiving crop in terms of labor schedules. Unlike rice and some other crops which have to be harvested when it's time to harvest them, if you can't harvest the cassava today you can get it tomorrow or next week or next year. So for farmers who oftentimes don't have access to a lot of labor resources, that's incredibly valuable. So for a lot of reasons I thought it was a great crop for the poor.

It also was a crop that was susceptible to a lot of viruses and it's a crop that had very poor nutrition. It's just starch. And so in theory we could use genetic modification to help it be more resistant to viruses. I mean that's actually been one of the small scale successes of GM crops has been virus resistance. A lot of people don't realize it but we've got virus resistant zucchini in the store and it's – some of its genetically modified so it's actually a technology that works fairly well.

So and the other thing we could do is find some genes probably from wild cassavas that will add – that will increase the nutritional content of cassava. So I thought that what we need to do is move beyond the general statements about GM crops feeding the world and say specifically what crops might actually have promise, and there were a few. So I wrote

about this in 2002 and I was for years quite impatient with the detractors of Golden Rice who, for instance, made a lot of claims about it that were just false.

I guess now it's 2017 and I've got to say I'm quite pessimistic about these crops as solutions. The crops that I was working on as an intern at the Danforth Center in 2000, genetically modified cassava, it's now 2017 and the stuff is years away from being ready. Part of that is that genetic engineering just is hard and slow and it's not a quick fix. Part of it's not their fault at all. They've run into some real headwinds in terms of tests they've had to do in East Africa on it that have slowed them down some. But part of it's definitely that the genetic engineering is not a quick fix.

You can't go in there with a surgical strike with restriction enzymes and cut out the genes you want and fix the crop but actually it's the molecular biology can be difficult, especially with cassava. And then the breeding can take a long, long time. So I'm pretty pessimistic about that and furthermore, if the genetically modified cassava does get approved, which may well happen in Uganda and/or Kenya, and released, the stuff that's virus resistant we may well find that the viruses will mutate so there no longer resistance to that. Viruses are great at that.

So I guess in terms of that my – I wasn't sure it was going to work but back in 2002 I was quite adamant that we need to keep an open mind and see how these things work out. With the cassava I've gotten a good – I'm pretty pessimistic about it. The Golden Rice which is a remarkable story in terms of the amount of propaganda that's been put out about it; I wrote in 2002 that it's over hyped, that there's propaganda and we need to look beyond the propaganda.

And the propaganda has continued more pro Golden Rice than anti Golden Rice, and earlier last year we actually had this letter signed by, you know, over 100 Nobel Laureates, most of whom were alive, one wasn't, who signed this letter claiming that Golden Rice was being delayed by Greenpeace and saying that this was basically a crime against humanity. And it's not being delayed by Greenpeace. I mean I've been doing research in the Philippines including with lots of interviews at ERRI, the International Rice Research Institute which is actually doing – they in collaboration with Phil Rice, the Philippine Rice Research Institute, are the ones who are actually developing Golden Rice. And it's still got years of breeding left.

And so they've been working on this. The idea [for Golden Rice] actually started back in the mid-80's and it's been a funded project since the early 90's and it's still years away. It has among its other problems it seems to have a yield drag; that is the rice that the golden

trait has been put into for some reason the golden trait seem to be making it yield a little bit less. So it hasn't even been submitted for approval yet. And so I not only have gotten fairly disappointed with that and we've got to be able to develop crops a little bit quicker than that.

And by the way, in the meantime all these years that they've been working on the Golden Rice, other sorts of non-genetic programs in the Philippines have managed to slash the rate of Vitamin A deficiency which is the malady that Golden Rice is intended to mitigate. So I've become pretty disillusioned with that. I still don't think it was a bad idea but I think the timing of it has been pretty disappointing. And I'm also really disappointed with the behavior of scientists in this one. You know if we really care about people in a developing world I think we need to be willing to say let's evaluate what sorts of solutions work and what sorts of solutions don't work.

And in this particular case there's no escaping the conclusion that Golden Rice has taken a long, long time to get it even close to being released. And if you're actually concerned about these folks, like these undernourished kids, as a scientist I think you've got to be able to face that which is a long-winded way of saying I've insisted on being open minded about pro-poor crops all along, and at this stage of the game I'm pretty pessimistic.

There's another crop that's being worked on which are Matoke bananas in Uganda. And in this country the banana is just sort of a fruit but it's a basic starch staple in Uganda. It's a different kind of banana, not sweet. And Matoke bananas have got a lot of problems with pests and especially with diseases and they are working on genetically modifying Matoke banana which I guess if there was one I was going to be somewhat optimistic about it would be that one. But after the long and unsatisfactory stories of the other pro-poor crops I think we'll just have to wait and see.

[55:25]

FG: Can I ask you about the cotton as a pro-poor farmer thing, not in terms of nourishment, in terms of health. So in China there are a number of studies sort of portraying it as decreasing the number of times that farmers wind up in hospitals at the end of the season from organophosphate poisoning. Did you see any of that in your system and do you think that's an accurate help to the farmer?

GS: Yeah, we don't have data on that although I would love to have data on that. We didn't – I mean I would have loved to have had a student who was actually doing research on public health impacts of these.

FG: Yeah.

GS: So all I can do is tell you non-scientifically what my sense is. My sense is that probably yes. I know that the farmers that we've been studying are spraying pesticides less. The pesticides they're spraying are different. It's mainly neonics now and a lot of the other ones that they were spraying have gone way down. The other ones that they were spraying included some very toxic ones and also some that were less toxic.

But in general the ones that were sprayed basically for the lepidopterans have gone down. So without having any data to back it up my sense is that there probably has been a positive health impact on the farmers. And then also the fact that there is overall less pesticide coming into the ground probably has positive, indirect benefits on the community that are really hard to track down. But that's only my sense.

FG: The Chinese studies – do you have any knowledge of those studies, or thoughts on those?

GS: I've seen studies that showed that the pesticide sprayings have gone down. I don't have an opinion on the actual going to the hospital, so I don't know.

FG: Yeah, yeah, okay. And…

GS: But that would be acute poisoning you're talking about, right?

FG: That's acute poisoning.

GS: Right.

FG: Yeah.

GS: Yeah.

FG: Yeah.

GS: I mean then there's also the chronic poisoning issues are so tricky. I don't think we probably have a very good sense, if we ever do, of what the long-term effects are of, you know, daily doses of neonics on the skin.

[57:40]

FG: So moving just a little bit further, you know the story of brinjal Bt eggplant?

GS: Yeah.

FG: And you know you see these different sides and that context too in terms of health and in terms of spraying, but also the idea that this is a Trojan horse, so could you comment on that a little bit, what your views of that are? Can you even see them becoming a Trojan horse for bringing in…

GS: I think the Trojan horse arguments have some merit in terms of the way narratives are controlled. If India had approved Bt brinjal which it didn't a few years ago and it was put out and it was adopted by farmers, we know perfectly well that there would be a lot of media that came out of industries saying you see GMO's are beneficial. And these crops are all different.

I mean as we were saying, you know, Golden Rice is very different than cassava, it's very different than Roundup ready soybeans is very different than Bt brinjal. And so if Bt brinjal was put out and increased productivity and reduced spraying, my conclusion would be at least up to now, at least in the short-term, it seems to be an agronomic success, this one particular crop does. That to me wouldn't tell me much at all about Bt cotton or Roundup ready cotton or other things.

So we know perfectly well that there would be a lot of media that would use that as a way of generalizing to the benefits of crops in the Third World. There's a lot of mixing crops all together and as a way of demonizing or valorizing GM crops in general. And the best way to see this is that almost every time you read an editorial or you see an Op-ed piece or something about GM crops, even if it has nothing to do with Golden Rice, they always mention Golden Rice because the point is that we're trying to find positive examples and using that to reflect on GM crops in general. So that would definitely happen with Bt brinjal. So in that sense I think yeah, there is danger of it being a Trojan. Yeah.

[59:59]

TK: So now I'm going to shift gears and sort of, not a rapid fire series, but it's more about sort of your career. So I'm going to ask these three and then I'll let you sort of talk. So if you could make kind of a graph of your career maybe from, you know, private school to now, you know, how would you sort of divide your career or could you divide your career in different sort of eras? And within that graph if you could map on top of that an optimism curve, where would you place sort of the highs and lows of that? And then the final one in this section is throughout that graph if you ever thought you were going to be fired.

GS: I'll answer the last one first. No, I never thought I would be fired. I'm not all that – I mean a tenured professor at a research university is tough to fire. And before I was tenured I wasn't, you know, I wasn't committing any high crimes or misdemeanors, but more

importantly, the work that I was involved with before I was tenured wasn't particularly controversial. I didn't get interested in these GMO issues where you can draw some flack until after I was tenured, so I haven't had to worry about that.

In terms of the career, graduate school is always sort of a chunk and then when I came out of graduate school I was an academic archaeologist. I was interested in living people. I did ethnoarchaeology but I was an archeologist. And I went to Columbia. I was an assistant professor and associate professor at Columbia and I was there from 1988 to 1995, and during that period of my career I was interested in issues that spanned ancient and modern people and they had to do with population and organization of agriculture and settlement pattern and conflict.

In 1995 my interests were increasingly oriented towards living people and I was offered a position as a cultural anthropologist at Washington University. So from '95 until about 1999 I continued doing the same sort of stuff I'd done except now focused a little bit more on the living people, and I was writing about population and conflict and things like that. I actually wrote a major paper on archeology during that period so I hadn't left it totally behind, but so from '95 until about '99 that's what I was doing.

Starting in 1999 I became very interested in these issues of genetic modification and so from about starting in 2000 on I have worked on – while still keeping an interest in some other topics I've focused a lot on issues of genetic modification and impacts on developing world. So that's gone on. Over laid on that starting in about 2010 or 2009 I also developed a real keen interest in alternative agriculture in North America, and so there's sort of a lexical gap, you know. Some people call it the New Agrarians or the New American Farmers or some people call them the Hippie farmers. But a lot of them aren't hippies.

But anyway there are a lot of sort of Renaissance movements going on in agriculture. And I'm sure that in Raleigh you've got a booming farmers market and, you know, those are proliferating – have been proliferating for quite awhile. And people like, you know, Michael Polland write best sellers about these folks and so on and so it's a really interesting movement. And that is only indirectly related to the continuing research on GMO's. It's related to it only in that the alternative farmers are all – I mean they vary in terms of lots of things, but they are all partly motivated by an idealistic vision of what agriculture should be.

None of them say I know, I'll make a killing, I'm going to open a small farm. I mean they all are driven partly by idealism and in some cases, I'm afraid, 100 percent by idealism. And one of the things that they're virtually all reacting against is what's happened with our

industrial agriculture of which GMO's are part. So they tend to be very anti-GMO but as a larger – as part of a larger aversion to industrialized agriculture.

So what I'm doing now is I'm still in that phase of my career where I'm interested in GMO's. I'm about five or six years into a period where I'm interested in small farmers. But as of this past year I've got this nice fellowship and a sabbatical year and I'm writing a book on the history of capitalism and agriculture.

[1:05:07]

TK: Is there a particular debate within genetic engineering that participated in that you feel most strongly about, and if you could maybe talk about what went well in that debate, what surprised you, what do you wish would have gone differently, if anything?

GS: That requires some thought. One thing – yeah, of the things I've written about GM crops in the developing world I wrote a paper in 2007 on what I called Agricultural Deskilling. And I was – I thought it was important but I was pleasantly surprised by how many people read it and thought it was important and so it's had a fair amount of impact. I was most proud of it in terms of theorizing the way decision making works and problems that farmers can have. That story was related to GMO's but also was a larger story about how farmer decision making works. So that's the part of it that – it's impact in many ways pleasantly surprised me.

The part that I was disappointed with was that a lot of people took it to be a story about how GMO's destroy indigenous wisdom which is not really what I said. And that got picked up by a lot of the press including several stories in the European newspapers that basically tried to use this as a club for beating GMO's, and the story I was trying to tell was a bit more complicated than that. So that would be one example. But actually that hasn't been that much of a debate. It's just been more a piece of scholarship that's had some impact.

Let me think about the debate thing. Yeah, there's been one debate that I felt quite strongly about or one issue that I've engaged in. This has been mainly through a blog of mine that got a fair amount of readership. And that has to do with how we go about as scientists answering questions about the long-term safety of our technologies. So in discussions about GM crops and GMO's in general you constantly hear people arguing about whether or not they are safe and you constantly hear the narrative that, you know, there's a consensus among scientists that GMO's are safe.

As a scientist that statement makes no sense whatsoever. It's like saying chemicals are safe. What you can say, and I believe this is more or less what Fred Gould's summary in the National Academy says is that we don't know of any presently available data that

convince us that currently available GMO's have got negative health consequences which is a very careful and pretty solid scientific statement. It's very different than saying GMO's are safe.

When you say that you say what GMO's, all GMO's? Does that mean any GMO that could be created is going to be safe? While we've been sitting here hundreds of GMO's have been created. They're created all the time. Are they all safe? Does that mean that any movement of any genes can have no positive and can have no negative impact which is a mind boggling concept. So I find that people's approach to that and I find it's been very disappointing to me that so many scientists have been willing to grapple with that issue in those what I regard as non-scientific terms.

One of the ways that I've written about this is with reference to the issue of DDT which also was known to be safe for a long time. So DDT – we all remember it as something that was first really demonized in 1963 by Rachel Carson, but DDT had been in wide use in this country since 1945 and there had been suspicions from very early on that it might have negative health consequences and there had been study after study that had failed to convincingly show that DDT had long-term health consequences. You could get acute poisoning from it, sure, but you can get acute poisoning from water.

So there continued to be suspicions that it had negative health consequences even though it was impossible for decades to actually come up with any sort of smoking gun. And then finally we had the Long Island study which was motivated especially by a bunch of citizens who became convinced that DDT probably was a cause of breast cancer and this government funded Long Island study looked at - well funded – looked at very large samples of people in different areas of Long Island and including lots of women who had suffered from breast cancer, and basically saying people have got breast cancer, let's see if they've got any sign of DDT or DDT metabolites in their blood.

And nope, nope, nope, and so this finally led to some articles in the New York Times where they said it's time to close this chapter. DDT is shown to be safe. We had reason to believe that it caused problems. We knew it screwed up the eggshell thickness in some birds and so on and so forth, but we have now seen it over and over and over again that it's safe. And Norman Borlaug, the fabled father of the Green Revolution talked about the safety of DDT in very vociferous terms giving speeches and writing in the New York Times about how the people who continue to claim DDT is bad for us are hysterical environmentalists filled with misinformation, fear mongering ignoramuses.

And it wasn't until 2007 that we had published research by very good epidemiologists showing that there actually is a link between DDT and breast cancer. DDT causes breast cancer. And this was only because they were able to get this treasure trove of blood samples from women and girls from back in the 1950's [and 1960's] and they looked in those blood samples for signs, you know, for DDT or DDT metabolites and found that the blood samples of girls who were pre-pubescent or before the age of 14 that had DDT in them were five times more likely to have breast cancer as grownups. They tracked down the women in the sample, so it has a very strong effect.

It took us 62 years to find that out. Now so the next time that you have a scientist say to you we know that GMO's are safe, you should be disappointed and I certainly am.

[1:12:16]

TK: So how would you – what's a better way to have that discussion around the safety of a technology?

GS: Well the first thing is to get a scientist to be leaders in all this and not to say things like GMO's are safe but to say things like, you know, we've got so many studies of this particular GMO and so far we've looked for this and looked for that we have not seen any health impacts, but we may find ourselves, you know, we'll continue to look. So scientists should lead the societal process of talking about these things. That's the first step.

The second step is that when any research is conducted that is suggestive or even slightly indicative of potential dangers, as scientists we should say whoa, let's take a look at that, let's do the study again, let's do it with a bigger sample, let's follow up on what we're seeing here. That's the proper way to try to evaluate the safety of technologies.
And what we're doing right now is pretty much the opposite of that.

When studies are published that are somewhat indicative that there may be, you know, causes for concern not just industry but scientists oftentimes, scientists who tend to be very involved in GMO fights, are very quick to jump on the research and try to discredit it and in the most disgraceful case got a major paper a few years ago retracted. And any of us in science know that retraction is a big deal. It can be a career killing deal. It's profoundly embarrassing.

A retraction is a huge deal if you're a scientist. And there are very specific criteria for retraction. This particular study by the French scientist, Gilles Seralini, was retracted for being inconclusive which is most explicitly not a criterion for retraction, and this was largely from pressure from industry and from allied scientists. And so if we're really interested in

the safety of things what we should do is say let's take a look at the research, the suggestions in the study and let's pursue this.

And the idea of – it actually has a real chilling effect on science if people are attacked in this sort of way and actually get articles retracted simply because they provided some even slight indication that there may be reason for discomfort about the safety of these crops. I mean the fact of the matter is if inconclusiveness is a criterion for retraction we're going to have to sweep my vitae clean.

[1:15:00]

TK: So we only have a few minutes left so I got a couple more questions. So what do you think has been or do you think there has been, maybe is a better way to say it, the most significant moment in the history of genetic engineering in agriculture and what do you think its impact has been?

GS: Well of course there have been lots of moments along the way. I guess my thinking is if we had to pick a sort of a crossroads or an inflection point it probably would be in 1995 – there's no one moment, but there's a fairly short period of time there where it came to the attention, especially of the British public, there's also some of this in Germany, but it came to the attention of the British public that genetically modified soybean oil was in their food supply, and timing of this was critical because in England they had had problems for years with an animal disease called Mad Cow or Bovine spongiform encephalopathy or BSE which is a terrible prion disease where misfolded proteins damaged the brain really severely. It led to an awful death on the part of the cow.

At the same time there was a human prion disease called Variant CJ in which you also had prions destroying the human brain and there was a belief on the part of the British public that the two were connected and the British medical establishment took a very firm stand on this saying no, they're both prion diseases but the British beef is totally safe, there's no connection between these two things and they were quite adamant about that.

Then in I think it was spring of 1995 the British medical establishment reversed course and said well actually there is one little connection there, BSE causes CJ and so this was a huge black eye for – I mean they retracted themselves and so the point is this was a moment of extreme lack of confidence by the British public in the medical pronouncements about what was safe and what wasn't.

And so then not long after that they find out that genetically modified soy is in our food, it's not labeled and if you want to know if it's safe the British medical establishment says it is. So that was an incredibly awkward moment for them. And by the way, GM foods had been

available in England before that without [much] controversy. They had been selling genetically modified tomatoes in the form of tomato sauce, and it said right on the can genetically modified tomatoes. And there had been very little resistance.

So those things came together in 1995 and I think that was a key moment in Western Europe starting to pull away from support for GM crops. And then I think most people who've looked carefully at the history of that moment would say Monsanto then exacerbated the situation by their response to it which was seen as very didactic and we know what's good for you and so on, eventually leading to Robert Shapiro, the then CEO of Monsanto, having to basically apologize on a big TV screen in front of a Greenpeace convention which I'm sure he felt was like sinking to the lowest level of Hell.

But that moment and what happened so after I think set the stage for the polarization that has plagued the discussions about GMO's ever since, and it's just built on itself since then to where most people who know something about GMO's, who write about GMO's, who talk about GMO's with few exceptions have got a dog in the fight. They're out to try to promote GMO's or they're out to try to bring GMO's down and they engage in what they call motivated thinking which is that when you're listening to somebody's argument if they're going against you you're not listening to whether it will convince you; you're just thinking about how you can bring it down.

And so it's almost impossible for us to have fruitful discussions now about GMO's. And I have to say that really worries me because of the biological crossroads we're at right now where we've now got CRIPSR. We've had gene editing around for a while but now as of very recently we've got this very powerful, inexpensive form of gene editing. And we as a society don't know what to make of CRISPR yet, and it raises really difficult questions. If you think GMO questions are tough, this stuff is really tough. And we desperately need honest broker scientists to help us work our way through this and they're not there largely as a result I would say of this polarization that goes all the way back to the 90's in the way we discuss these technologies.

[1:20:15]

TK: So do you have a solution to I guess like maybe this larger question that you were addressing which is sort of the public's level of trust in the government like you were saying, you know, in the British health establishment but also in university scientists and private companies?

GS: No. I don't. I'm glad that I'm not president of a major research university to have to deal with these things because I understand why these close relationships in terms of money

and research and thinking have developed between industry and scientists. I understand why it's there. I don't actually have a solution to it.

TK: So I think we've pretty much exhausted all the questions that I have here, but we also like to ask was there any questions you thought we might ask you that we didn't that you want to answer?

GS: No, I think we've covered it all.

TK: And then the other one is…

GS: [inaudible 01:21:23]

FG: I have one but no, go ahead.

[1:21:30]

TK: I was going to ask are there any other people that you think we should be interviewing for this historical record of this field?

GS: I would talk with Robert Pollack of Columbia University both on the GMO thing and the CRISPR thing. Very interesting guy who played a very interesting role in all this.

[1:21:56]

FG: Interesting, okay. So the question that you may or may not want to answer, is there a person who has very different views on GMO's that you respect? And why if there is?

GS: I think probably the main person who would spring to mind would be Dr. Nigel Taylor of the Donald Danforth Plant Science Center. First, because he has been – I mean I've known Nigel since 2000. I've had him come and talk to my class a lot. I've been to his house; he's been to my house. We drank a lot of good scotch together and he's never bullshit me, and he is a professional genetic engineer. He is the one who is running the lab for Claude Fauquet and so in the first place he's much more of a straight shooter which I have to say is not always the case with a lot of people. I've been on panels with people who have just made, you know, what's the Trumpian term, statements about alternative facts.

So that's the first thing. The second thing is he actually has been involved in trying to develop crops for the poor which very few people have been, although there's a lot that's discussed about this. There certainly have been crops that have come out of Monsanto where they're arguing that these can be sold to the poor but they weren't developed with the poor in mind. Nigel has been specifically working on things like virus resistant cassava and bio-fortified cassava which are not going to be corporate money makers ever.

And he's been working on them for a long, long time not only doing what he does best which is real technical training he's in which is tissue culture, but doing all the different aspects of creating transgenic crops and he's been involved in the breeding and he's been involved in actually flying plants over to Kampala and to Nairobi and trying to get them out into the – and so, you know, if you're producing GM crops for a corporation like Monsanto you've got the gene jockeys and you've got breeders and you've got regulatory people and you've got public relations people and you've got IP people and so on.

Nigel has to do just about all of that, and he's been actually trying to get crops into the field which are the crops that I had said I think probably do have some promise for people in developing countries. And the other reason that I would cite him is that he's been pretty open minded. So I have – I teach a big course on sort of biotech and society and we have custom in there that when we have guest speakers come in we have a dinner with students who sign up. We cap it at like 10 or 12 so we can have a conversation and we get beer and pizza or Chinese takeout and we sit around for dinner and talk about what they talked about and related things.

And so and Nigel has been a repeat visitor there so we've had dinner with students probably, you know, four or five times over the years. And at the last one of these dinners somebody was asking us about whether or not people in – they were saying – one of the students asked a question something like it seems like it's so polarized that nobody ever convinces anybody of anything at which point I turned to Nigel and I said he's convinced me of some things, and Nigel said you've convinced me of some things, and we both said you kids don't understand what a rare moment this is in the world of GMO's.

[1:25:42]
[laughter]

TK: Great. All right. So thank you very much.

GS: Thank you.

TK: For the time. And that's it.

GS: Great.

FG: Good. All right, that was great.

[1:25:50]