

The Genetic Engineering and Society Center History Project

Interviewee: Margaret Mellon

Interviewers: Matthew Booker, Alison Wynn, and Brad Herring

Videographer: Brad Herring

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Biographical Note:

START TRANSCRIPTION

[00:00]

[Matthew Booker]: Should I introduce myself first is that what we're doing? We're giving the date aren't we? Yeah. So this is Matthew Booker. It's the fifth of September 2014. We're interviewing Margaret Mellon. Could you tell us your name, your institution or your current place of work, and your role?

[Margaret Mellon]: My name is Margaret Mellon and I am currently a science policy consultant. I consult for entities that I worked with before I retired.

[M.B.]: And what does that look like in practice? I mean what is it actually that you do if you were to explain to somebody in a practical sense.

[M.M]: Well, right now I work with a coalition that is trying to stop the overuse of antibiotics in agriculture. So on a daily basis I edit press releases, sometimes write summaries of scientific articles, deal with reporters who have questions about the technology and do a lot of brainstorming with people on the coalition. For one of my other clients I am writing a fact sheet on new genetic engineering technologies. I'm trying to figure out gene editing and similar technologies and just writing a basic fact sheet on it so that people in the organization will understand them. I don't know whether we will use it on the Hill or elsewhere

[02:05]

[M.B.]: So that's a range of skills, clearly, in your answer there and so before I ask you specifically how you got all of those, is this what you wanted to be when you grew up and what did you imagine yourself being?

[M.M]: Oh, I had no idea that I would end up where I am now. If I think back, my life was going from one lily pad to the next in the pond and I never saw farther than the next lily pad. I didn't have any grand scheme. Not when I was going into college, or leaving college. I was very short sighted about what I might do next.

[M.B.]: So how did you end up going into these careers?

[M.M]: Well it's interesting that you should ask. As I said, I was not very ambitious. But I was very interested in ideas and I read a lot. I decided to go into science because I thought I'm going to read about English literature, I'm going to read about sociology, I'm going to read about a lot of other things. I'll never read about science. It's too hard. And so I thought to myself, well I'm going to go to college, I went to Purdue University, and declare a science major because then I'll have to. And I did that and I took science courses as you have to, but other kinds of courses as well. When I got to the end of my undergraduate years I really thought I'd be a high school English teacher, I mean a high school science teacher. But somebody enticed me to just stay at Purdue for another two years. I did some teaching of undergraduates and I pursued a Master's degree with a charismatic professor and after I had been doing research for two years I was hooked, and I decided I really wanted to get a PhD and I knew I could do that level work so I decided it was time to branch out. I went to the University of Virginia to pursue a science PhD in science and was there for quite a while. I loved science, but eventually I got married, and one of the things you realize, that I realized, was that I couldn't go to another institution to pursue my career because if you're married you can't do that. So that limited my options for a tenure track position. As I remember it, the only way I could have gotten a tenure track position at UVA was to go into the Anatomy Department. They said if you're willing to take Gross Anatomy one year, to TA the next and teach during the third, we'll put you on a tenure track position [*laughs*] in the anatomy department. And I just couldn't handle that. But realizing that I had limited options in science, but a broad range of interests and I happened to be living in the shadow of a really great Law School, which was the University of Virginia Law School.... I had friends over there, took a course called Law for the Layman, that will show you how long ago it was, they dared call it "Law for the Layman", at night. But I was intrigued, I talked to one of my friends, and he said "a year ago if you'd come here we would have said you're wasting your science background by going to Law School." There's no career available that's going to use that intense science education, but my friend, the Dean of the Law School, had just come back from working as Chief Counsel for the FDA, and he said "the world has changed and from now on there's going to be a big demand for people who are good in science and understand it and who are also accomplished in the law." He said, "I'm changing my advice," he said "come on over" and I applied and got in with the idea that I would give it a year. I figured after a year I could always go back into science. I hadn't been away that long that I could pick up where I left off, so if it was a risk, it was not a big one. But I thought if I did like it I would stay and I did like it. I worked with Richard Merrill who was the individual who had given me that advice and it turned out to be quite a fun adventure. Do you want me to just keep going or do you...?

[07:50]

[M.B.]: I was going to ask Alison if she had anything she would like to follow up on.

[A.W.]: What do you think your most important contributions have been to your fields?

[M.M]: Oh my God. I don't know. I think I'm looking at my field as the science advocacy work I've done on agriculture and, let's see, looking just at what I've done in science advocacy in Ag and Biotech, I think I've made a contribution in providing a knowledgeable and rational voice on the public interest side of the debate. I think there are just not that many people who have science degrees as well as law degrees who have engaged in the debate on this side so I think that has proved to be a contribution and I hope has made some small difference in making it a more rational debate.

[A.W.]: When and how did you get interested in genetic engineering and biotech?

[M.M]: After I finished Law School I did three years in a law firm and decided that being an environmental lawyer wasn't what I wanted to do as a career so I went to an environmental think tank in Washington, D.C., the Environmental Law Institute, and that was just at the time when the whole biotech and genetic engineering was bubbling up. People were interested in it and many people came and asked me questions because they knew I had a PhD in science and I was pleased to be asked and to share what I knew. So then somebody said why don't you write a law review on the regulation of this new technology, which I did and that drew me into it. I started going to meetings because people needed, they wanted, they set up these meetings to kind of persuade people that it was a good technology and to engage them in the coming regulatory debate. So there were a lot of invitations to go to things, which I accepted. So eventually I got pulled in and then one day someone from the National Wildlife Federation came to the Environmental Law Institute and said we want to start an advocacy center, a policy center here at NWF and who do you think would be a good person to head that up? And eventually, we decided that I would be a good person. I was delighted to take the opportunity. I just leapt at it, and I went to NWF.

[11:00]

[A.W.]: And why do you think this technology matters? What's at stake?

[M.M]: Gosh...I think the answer to that changes. In the early days, I was quite susceptible to the notion that this was a uniquely powerful technology that would transform agriculture along the lines that people promised. I just didn't know enough about agriculture perhaps, to really understand how daunting that was, but I really believed that. So then I thought it was the technology would enable what couldn't be done otherwise. The more I know about it, the less I believe that. If you ask me right now, I'd say it's a technology, at least as we've seen it for the last 30 years, that has made very modest contributions to agriculture. I would say if we hadn't had genetic engineering at all in this country our agriculture would be very much like it is right now. It would be very much like what you see in Europe. They've not accepted the technology. They still have a highly productive, highly subsidized, pesticide intensive agriculture that looks a lot like ours. I don't think it has made a difference in the way our agriculture looks despite what a lot of people expected and certainly hoped.

[M.B.]: Is there a particular controversy or episode that you've been involved with related to genetic engineering that you think is most interesting to think about or that might reveal some of those tensions?

[M.M]: I don't know. One of the things that I and people in my program at the Union of Concerned Scientists were involved in early on was to try to look at the at one of the implications of the BT crops. These are crops into which the *Bacillus thuringiensis* toxin had been engineered so that the plant made its own pesticide and you didn't need to exogenously apply the pesticides to control pests. That was a very interesting application. It raised several issues, one of which is that the organic community had been using BT for a long time without resistance being developed primarily because they used it in a form that disintegrated in sunlight so it was never around long enough to elicit resistant pests. One of the concerns was that the way BT would be used by genetic engineers would inevitably lead to resistance and that that resistance would affect the organic community which didn't want to have anything to do with genetic engineering technology, as well as the folks who had adopted it. So, we tried to engage in that issue. It turned out that there were scientists, population biologists, who had a plan, based on their understanding of insect population biology that would allow the deployment of the technology in the crops without the resistance developing, but the plan did depend on farmers doing something that farmers don't want to do, which is giving up a part of their land to non-BT crops that would be susceptible to pests and not doing anything about the subsequent pest damage. Now that's asking a lot of a farmer. To say take this hit today, let those pests chew up your crop, because in five years, that pesticide is still going to work. So it was a hard sell. It was based on science that people didn't really understand. But it was really an important thing to do both for the conventional farming community as well as for the organic farmer community and we tried to make that happen, using all of the tools that we had. We produced a report called *Now or Never*. We asked scientists to write it, to devise crop-specific plans that would prolong the durability of the technology, went to all kinds of meetings, did all kinds of press work. Everything that we knew how to do to encourage this unnatural marriage between science and the agricultural community, which surprisingly worked. Now, it wasn't just because of us, it was driven by the conventional ag folks themselves, but it didn't hurt that there was a strong voice coming out of the environmental community that wasn't saying "just don't do it," but saying "do it this way. This is a better way." And so I was always proud of that. Over time of course, the economics of the issue meant that refuges, the non-BT portions of the farms, were not employed. And of course, that's one reason why resistance is now setting in. I was proud of that and I still think it points to a direction where there are good ways of putting science, agriculture and new technology together, and hopefully making it work for more than one community.

[18:29]

[M.B.]: So you've described an interesting conjunction there of thinking scientifically, being loyal to scientific facts. And at the same time recognizing the kinds of pressures that exist in the world of economics and agriculture, which is a fundamental business in this country. As a scientist then, who has chosen to operate in the world of policy, how

do you negotiate that tension between those two worlds? And what I mean by that, is that you usually think of scientists as sort of objective, as faithful to their results, the kind of loyalty to a particular method, and who are careful to make claims only based on what their evidence what their facts suggest. But policy is about values and it's about futures as much as it is about past results, right? So what about those moments when there's scientific uncertainty, in your opinion, but there's immense pressure for new technology, when you feel you do not have enough info to move forward. Do you have an example you might provide for that? Or is that too much?

[M.M]: I think the role of scientists is very important. I agree with you that scientists are loyal to a set of standards in science and that does lead them. They are very cautious in the interpretation of their results, but I don't know. Scientists are also very naive, they actually, a lot of them, think they don't have a political view. That they can do an experiment, get a result, and tell somebody about it and that can somehow be divorced from a political or sociological context, which is just [*whispers*] impossible. Every bit of science is embedded in cultural and political context and one of the problems with the debate is that scientists didn't understand the way they were embracing an industrial view of agriculture without ever considering that there might be another way of doing things. But I'm trying to think if I ever thought that herbicide tolerant crops, for example, should not be approved. We wrote a report called "Biotechnology's Bitter Harvest" showing that resistance will develop; there are a lot better ways of doing this. And, we researched databases. But we were ignored so I guess I just, I'm not sure how to answer your questions. I mean, we made those arguments, we thought we made scientifically valid arguments they've been borne out and they weren't particularly sophisticated, but they just ran counter to economic and political reality and we were basically rolled. So in general, it's hard to say. People have often said to me, well Mardi is there some piece of genetic engineering that you would whole-heartedly support? And I did come up with five, five genetically engineered products that I would like, they were all microbial or yeast drug production or something like that. But for all of the really important products, I think it was our job to be the opposition and lay out a reason why you might not want this technology even if I thought on balance that would be outweighed by the good. I think somebody has to lay out the case against it, which we did, it's hard to say. One reason I'm wavering whether we won depends on the context. If you consider the regulatory context, the USDA proposes to approve something, it takes comments and then decides do something. We almost always lost in that kind of environment. But in broader public debates you could argue that at least after a while we began to win. Even if products were being approved, the affection for them became much less and so we were winning in the court of public opinion where we weren't winning in a regulatory context.

[24:29]

[M.B.]: So that wonderful comment makes me think about the allies and the opponents that you've had at the Union of Concerned Scientists over the years. And your approach is clearly based on your allegiance to scientific evidence—

[M.M]: Absolutely.

[M.B.]: You've been very clear about that. But the word "we" that you used I think refers to you and your team at the Union of Concerned Scientists—

[M.M]: Yes.

[M.B.]: But there's a broader community of people who've used other kinds of arguments. Some of them quite unscientific arguments or emotionally based appeals who you might have found on your side in some of those arguments.

[M.M]: Oh yes.

[M.B.]: And those folks have gotten a lot of attention and maybe even some of the successes of the opposition—

[M.M]: Exactly.

[M.B.]: How did that feel and how did you work with those people? Did you respect those people? How did you handle that as a scientist?

[M.M]: Yeah, that is really a tough question. I mean once you realize that you're an advocate, that means you're trying to get something done in an imperfect world, then you work with people that you may not agree with across the board. And as I said, we within the Union of Concerned Scientists discussed these issues of how we would portray the technology and Monsanto. We came to our decision, but there were a lot of other people on our side who were way over the top as far as I'm concerned. And made very outrageous claims about the danger of the technology, I mean an almost moral, imputing a moral deficit to employing a particular technology that I just did not agree with at all. But how to deal with those folks who are in many ways...It's more than being just on the same side, in a tactical sense, those kinds of arguments are the ones that can produce 10,000 comments going to USDA whereas nice, rational Mardi-type argument, 25 people would be right behind me. I mean I wrestle with this even today. If I look back and I'm honest I would probably say our view was to never say anything unkind about people who are basically moving in the same direction you are. Even if you don't agree with that approach, you don't go out in public and say "I condemn X for having used that terminology. It's not correct." So mostly that's the way we handled it. We did some in-house within the community kind of stuff formally and informally. People were ostracized from the community for being just too far over the top. But it's really not an easy thing. And as I said in my talk today, I really believe that the same tactics are employed on the other side. I think implying that this technology could help feed the world, everybody has known that that is not the case. Productivity is not related to hunger. There's no evidence that increasing the production of corn and soy in the US has ever helped combat hunger across the world. it is a factually untrue but emotionally very compelling argument that people used all the time. And I can wonder the same thing about them! Did anybody say this is not about feeding hungry people, it's about feeding Monsanto's coffers and shareholders! Can we really say that? I think figuring

out what you can say yourself is a problem, who you ally yourself with. It's something that I worry about, I think about. Did we make the right decisions? You know, I'm not sure.

[29:30]

[M.B.]: So on that same vein, were there opponents, people on the other side of the issue, whom you particular respected or whose approach you respected?

[M.M]: Well, yes! One feature of my career is that I did get to spend a fair amount of time in these consensus raising or advisory committees. One was the Keystone Dialogues that were held for almost four years in the early days of the biotech issue. I was on the USDA's, Biotech Advisory Committee, which advised the Secretary of Agriculture on these issues. But all of those committees involved people from industry, people from government, people from the public interest community of all stripes, all sitting together trying to work through various issues. So in those contexts, I got to know people well. And I respected a lot of them and still do. As I said, my view is that we each have roles to play. I didn't expect the Monsanto representative, to embrace our view of the world, but I did respect him for being honest, that's probably the primary thing for me, being honest. Here's what we're going to do Mardi, here's the reason we're going to do it. I know you're not going to like it, you know I can't do anything about that and we'll move on. But an honest dialogue where people don't personalize the issues are not vituperative. That's what I value and I got that from a lot of the people that I worked with on this issue. People from the scientific community people from Monsanto and DuPont, Syngenta... I have a lot of respect for a lot of people I deeply disagree with but it's not a personal thing at all. I once met [Robert] Shapiro the CEO of Monsanto in a small setting with a group of NGOs and he asked us what we thought they ought to do. I and I said I just think you really ought to get out of the GE business. You ought to try to use conventional seeds and conventional methods. Maximize their potential. He said, "You know I can't do that. It'd be like cutting off my foot." But of course the interesting thing is that, now this is for history, it could have done that. Monsanto's bought enough of the seed industry. It has vegetable seeds, conventional seeds of all kinds. They have a lock on corn, soy, it could have walked away from genetic engineering and continued its dominance of the seed industry in the food system through conventional technologies, which from the point of view from history might be an example of "be careful what you wish for." Because it really could do it. And having sat and listened to them in conversations, over all those years, they might someday do that. The tech companies have made an awful lot of money, but the food companies don't like them, the international traders don't like them, they're just a headache. "Would you get your technology out of my grain trade? I can't ship my grain around the world." Someday, all of those pressures may actually force Monsanto in that direction. They'll do that, like I said, they'll do that for their own reasons, which I can't gainsay. They are companies. They're supposed to be making money. I just wish society had a better vision and a better way of reining them in.

[34:38]

[M.B.]: You just described, over the course of the last few minutes, a really interesting and I think profoundly ethically based idea of the process by which decisions should be made. And I'd like to draw you out about that a little bit. Because I think what you said earlier on is that you saw yourself as having a role. You and your team. And they were part of a larger set of interests, if I can apply that word—

[M.M]: Sure.

[M.B.]: --and that all of those interests deserved to be a part of the conversation. And so I wonder if you could flesh that out a little bit for people outside of your own self. How do you think decisions ought to be made about genetic engineering in particular, but more broadly about biotechnology or about agriculture in our society?

[M.M]: Well I do think there's a fundamental principle that in a democracy a broad range of affected interests ought to participate in important decisions and I think that that's the right thing to do. I also think that over the long term, societies are more likely to accept technology that is implemented in ways that reflect the desires of a broad range of people. So I think that we need to have those processes. We don't have them right now, although we have surrogates for them. Congress obviously is representative but it has a hard time dealing with technologies in any case, but it's the right place. But it is so short term in its focus. It's not the right place to make these long term decisions. The regulatory processes also bring a lot of people in the debate, but they ask the wrong questions. They say, here's the biotech crop. Is it safe or not? The processes don't allow you to look beyond that product and see if there might have been a different way to accomplish its purpose. When I think about genetically engineered animals, they were regulated by the FDA, but the FDA says "well we only want to talk about the risks to those animals or to humans from eating those animals. Well that's not what society cares about. It cares about lots of things about animals, but first of all are they in pain? Do they hurt? Is this an appropriate relationship for us to have with animals, to turn them into headless meat machines or whatever? All of those questions. But when the government says, "Well we can't deal with those questions." Then you say, "Well, where else can we go? Where do you take your concerns about the appropriate use of a technology to affect animals if not to a regulatory system?" I really would love to see somebody try to think of some better ways of having some of these conversations. They've made a start in England, you know. They have conferences where they bring ordinary citizens together and they brief them on different sides of the issue and ask them what they think and that's a good approach, but just recognizing that we don't have these institutions where discussion of all the issues are allowed. If you had such a group and they all said, "Yeah well we don't want to do headless chickens that can produce meat." That would kind of settle it. Society wouldn't do that. I wish that somebody somewhere would start thinking about new, inclusive processes where all kinds of concerns are heard. And then, in some way influence decisions. I think you could not do that right now. Monsanto would develop whatever it's going to develop and as long as nobody rejects it in the marketplace, the fact that a group of citizens said,

"Hey I don't think that's a good way for you to go," wouldn't influence how it made decisions.

[39:43]

[M.B.]: So, what do you think fundamentally is wrong with the process then around regulating or deciding, asking the right questions, these pieces that you describe?

[M.M]: I, I don't know, I don't know. I do think that we have not considered until recently that we are process-challenged. And so, you know, we just kept moving forward with the, with the institutions that we have, the regulatory bodies, the legislation. We've just been kind of stuck with what came from the past. I guess it's a deficit of imagination. And maybe it's because, until the last 30 years, maybe until the nuclear issue, people did not think about technologies as technologies. They didn't conceive of them as something that a society could say no or yes about. We had technology everywhere, the Brooklyn Bridge, a hugely dangerous technology. But it didn't occur to anybody to say to society, "Do you want it or not?" And it's only recently that have we started to think about technologies as technologies and to ask that question. Maybe it's just because in agriculture we have the luxury because the existing technology is so immensely productive that there's nothing that drives a new technology in ag. We have a surfeit of food. Our farmers' problems are too much food and low prices. So the very success of agriculture enables us to kind of sit back and think about new technologies because so little rides on it. Now if people were truly hungry. If they thought that they or their kids couldn't eat, this would not be a technology discussion. This would be an application discussion. What can you do for me? I think it's really an important question, but I can't imagine that as we go forward we're not going to evolve some better ways of having these conversations.

[42:48]

[M.B.]: So I would like to ask you a few kind of big picture questions. Some of which speak to your experience with the field and your interest with the history of genetic engineering. And so one is what you think are the most important drivers of the field of genetic engineering and agriculture today. What do you think is really driving the efforts to push the technology in new directions? What's back of these shifts?

[M.M]: I think, I don't know. I think the biggest driver behind biotechnology right now, is the scientific establishment. Is simply the fact that you have scientists who are knowledgeable about and employing kind of particular kind of science to come up with new products? That creates pressure coming out of the scientific community, scientists who love to do this research and just wish somebody would say, "Boy, I need that, so they can do more of it" That's a fundamental push behind the technology. And I think that as one of the gentlemen said today asking a question, there is a push for the technology that comes from the ability to use the patent laws. Although patenting is useless alone, but the patent laws in conjunction with market power, that means big money. And I think a technology that allows a commercial entity to put together patents

and market power and control their markets is very powerful. So you're always going to have people in the private sector looking for these opportunities. So that certainly pushes it, but as I said, I no longer think genetic engineering is inevitable, I would not be surprised if, we end up in a couple of decades and people say "well we tried it, we had a couple good applications but a lot of things happened and we just don't do that anymore.

[45:29]

[A.W.]: So what do you see as the future of agriculture in, say, 20 years?

[M.M My vision of agriculture would be sustainable, it would mean an agriculture that is highly productive and easy on the environment and good for people. And I think the only way, or the best way, to do that, is to solve all three of those problems at the same time with an increasingly diverse agriculture that values the public goods represented by a clean environment. When you look at pests you don't say, "Well can we control the pests?" You say "Is there a way to control them that would not impair productivity?" You check off yes, you got one. But will it pollute our air and water? And you'd say, "Well wait a minute, chemicals can control pests, but if we could rotate our crops, we wouldn't have pests in the first place and we wouldn't, we wouldn't have all of these pesticides in the environment And we could use cover crops so we wouldn't have excessive reactive nitrogen in the environment. If we looked at our real problems: our environmental problems and our need for sufficient food and exports, we can see t obvious solutions. Now in order to get there, you have to redirect the subsidies, reorient the USDA Research Agenda. So you would give farmers incentives if they rotated their crops, if they had a long crop rotation, farmers would get the billions of dollars that they now get for just growing too much corn. But the subsidies would be in service of providing environmental benefits, what we as a society would get out of it would be clean air and clean water. We wouldn't have lost the Gulf of Mexico or the Outer Banks to dead zones. The sad thing is that it's so obvious how you could do this, but you need to take that vision and then you need to put all the building blocks under it to make it possible for people to achieve it. Right now people, farmers tell me "I'd rotate in a minute, Mardi! You just tell me what crop I can plant and get the same amount of money as I can corn and I'm right there." And of course the answer's is, we don't have other crops. That's because we've never put money into developing a sufficient variety of uses for other crops and because we're not willing to tell farmers, "Because, by rotating your crops, you're protecting my air, I'm willing to give you that money. Mostly we need a vision. I think that vision would not allow us to use any of the world's best agricultural land to grow fuel. You just don't do that. And you certainly don't do it at the same time that you talk about the importance of dealing with a burgeoning population. I mean, anybody who cares about a burgeoning population is not going to put a third of the corn crop, or more, into fuel. But my vision, which I think we could accomplish, would be a lot more people growing a greater diversity of crops on, not necessarily small, but probably smaller farms, and f supported by policies and incentives in research that would enable them to make the right decisions and still send their kids of college. It's there! I see that so

clearly. I see that vision and I want us to get there. But all we can think about is herbicide-tolerant crops.

[50:34]

[M.B.]: One of the, one of the most important topics in our conversations today in the United States, in fact in the world, especially, is climate change. And in fact, the British geographer Mike Hulme has referred to the "tyranny of carbon"—

[M.M]: Yes.

[M.B.]: And carbon has overtaken all other kinds of threats and sort of swallowed the future. How does carbon play into this story that you're telling about an agriculture of the future? I know some people have claimed that the kinds of GE technologies might lead to fewer, to a lighter carbon load from agriculture.

[M.M]: Well, two things. One is that I do think climate change is an apocalyptic quality threat to the future of the globe. I probably, however, think that disruption of the nitrogen cycle is an equivalently apocalyptic threat. We're actually screwing up both of the big cycles on which life and this planet depends. And we need to take much more seriously the reality of those threats. And, there are lots of things that we can do about them. Do you want to cut down on the use of fertilizer? Cover crops are the most logical thing to do, but these solutions have to be sustainable in the sense that they're both good for the environment and good for productivity. Now whether GE has a solution to offer is just a factual question. Early on people thought that because GE encourages, conservation tillage or no-till that it would have a good effect in terms of climate. But we now know that that isn't the case. People have done research, and they have found out that the carbon in a no-till system does accumulate in the very top layer of soil but that in the deeper layers of the no-till system, you actually are losing carbon. Now there are other reasons to do no-till, but not to address climate change. Is there anything GE could do? And, I think the problems are so important that if I could think of one I'd give it real serious consideration but I really can't. The way we're going to deal with climate isn't by introducing one kind of crop versus another. I just haven't seen an application that even wildest imagination would make a big difference. But simple things like eat less meat, grow less corn, those would do a lot on climate change because agriculture is a big a big source of both methane and carbon. But this means changing people's diets, and coming up with better ways to raise, animals, which we haven't talked about. So there are big solutions. I wouldn't want to hold off on something as effective as getting people to eat less meat waiting for genetic engineering to come up with a solution. But as soon as you hear about an application that would really make a difference, I'm all ears.

[55:52]

[M.B.]: So if I could think about the past a little bit with you—

[M.M]: Yeah.

[M.B.]: Because you have such an interesting and long-term perspective on genetic engineering. You've been involved in so many different aspects of it. What do you think has been the most significant moment in the history of genetic engineering so far? Is there a critical moment you can point to in its history? An important or critical moment?

[M.M.]: I think the most critical moment in the history of Ag biotechnology was when the Europeans said we want to label the products of the technology and the promoters of the technology said no. And they did it in a very ham-handed way. That basically alienated the Europeans in a profound way that the technology has not yet recovered from. But I remember those days. I remember thinking, as I said, we in the US made regulatory arguments against the early biotech products and we just got rolled. It certainly looked like in the U.S. there was just nothing out there that could stop the combination of the companies and the scientists and the State Department. But all of a sudden we began to hear, and I made a lot of trips to Europe, We're not exactly interested in it. I'm not being very clear here, but, but I think there was a moment in which I thought the technology would proceed completely unimpeded based on its start in the U.S. but that it ran into a wall in Europe and that was the moment at which there was a much broader and much more serious discussion about the technology because it appeared a group of very powerful people were just going to say no. And they were basically saying was, we can live without it. When a technology is premised on inevitability and it's going to bring forth all these great things to have Europe say, "We can live without it," furthermore "and we'd like you to label it." That's big deal. And the companies were just adamant they would not label it. They fought against labeling, but they made people incredibly angry in Europe. And that was a turning point in this onward march toward taking over agriculture around the world.

[M.B.]: Why so? I mean what were the consequences of that European refusal here in the United States or in the other areas like Latin America where GE has been strongest.

[M.M.]: Yeah, I, I think, first of all it, it turns out that Europe of course is a big market for products from around the world. Not only did they refuse to accept the technology themselves and preceded to do quite nicely without it, but they also enacted labeling laws and those rippled back off through the grain trade so that people who were trying to sell products into Europe, needed to make sure that they that they weren't genetically engineered, which, which meant they couldn't contain certain percentages of GE product. But that had an effect on people who wanted to supply Europe not being able to develop technology because they wouldn't be able to sell the products of the technology to Europe and they wanted to maximize their markets. As I said earlier having sat and listened to tech companies, the grain traders, and the food companies talk in some of these consensus forums as I've done, it turns out the technology was very appealing to farmers but did not have anything to offer to the food companies. For them it is just a headache and similarly it's just a headache for the grain traders. It does not make their lives any easier. It just creates this new set of complications, new expenses for testing. For the food companies there's nothing. There's not even a

product that's conceivably interesting enough for them to want to take any kind of guff for the technology. And so, those were the beginnings of splits between big food and big Ag. Now many food companies want to supply Europe. They're sourcing non-GMO in the U.S., even though they're not saying it, in order to sell to Europe. A lot of what came out of Europe made this a more contentious and hassle-prone technology and affected its acceptance. And then there also was in Europe more than here, an opposition to the technology that believed that science and technology could be evil based on their experience with the Nazis and Germany. I went to Europe in those early days and that is what they talked about. They weren't willing to say, "Oh it's a brand new kind of technology that nobody will understand but we're really confident that it's going to be good for all of us." Europeans were suspicious in a way that I don't think I completely understand but it empowered them and provided momentum for an opposition to the technology that eventually went around the world.

[1:04:15]

[M.B.]: So you described one, I think, very hopeful vision of agriculture. Describe for us some sense of the history of its last phases. If you had a kind of nightmare scenario. Your greatest, or maybe I should put it this way: What are your greatest concerns for this technology, agricultural biotechnology?

[M.M.]: You know, I really I don't think this technology is dangerous in its current applications. I stand ready to be corrected, but I think it is not a food safety threat. New technologies might be different, but my biggest fear comes out of the enormous attention that has been paid to biotechnology. The hope that it can get us out of problems easily and miraculously. That has made it impossible for us to proceed to more fundamental change that would actually to solve our problems. So my biggest fear is that we, you know, we end up in 20 years with biotechnology that basically still isn't working, I mean it is being applied but we're using way too many herbicides and insecticides, our water is polluted, our air is polluted, all the while we're paying all subsidies for even more corn and more soy beans and that we haven't really addressed any of our fundamental problems. By that time, I think climate change and disruptions in the nitrogen cycle will be playing havoc with our environment and we will not be in a position to do anything fundamental about it. In my nightmare, we would just be flailing around, still hoping that there will be magic that will get us out of this instead of taking concrete, wise, steps based on what we know now we need to do.

[1:07:03]

[M.B.]: I have a last, fairly large question for you, but before I get to that, Alison and Brad, are there questions you wanted to ask or follow up on with Margaret that haven't occurred to me?

[B.H.]: I'll start. You mentioned this conversation that needs to happen with the various publics that are out there so how does that take place? How do we manage that? That's

one of the things that's talked about with this Michael Brown issue. We need a conversation that takes place, but how? How do we do that?

[M.M]: Well, right now I think we have imperfect attempts at that conversation. One is, is labeling. The labeling initiative. A lot of people will be saying I may not understand the technology but I want to choose what I eat and what I give to my family. That becomes a place where you can have conversations with people saying some version of "I don't trust you, the biotech industry. I don't see the benefits of what you're offering. I want the opportunity to not go where you're going." There are other ways of having these meta-conversations over issues and initiatives. People may come up with new modes of doing it, but it's not easy. It is like Michael Brown. You do need to bring the people into the same room that say "I know how that man felt when the cop was walking down the street after him" and somebody saying, "I don't." And then you actually have to talk about those differences. People saying "I don't get why you need to do this to the food." Talking to people who say, "well, I really love doing biotechnology. I want to do it." And how, how do you get them to listen to one another? No magic answers here.

[A.W.]: How do you feel about the public's level of trust in the government, university, and private work, and GE?

[M.M]: Well it has a lot to do with the public's trust in government across the board, which isn't great. We're at a time when people don't trust government... and that's not good. I mean, it really isn't. But, if you do surveys, people do trust the FDA pretty much, and they do trust other entities in government. I think scientists are still held in generically high regard, so certainly the proponents of the technology and the developers of the technology have a lot going for them in that there is a kind of willingness to be excited by science and to be trustful of scientist. But whether you can build specific trust in the technology is a different question and I think a lot of things that militate against that. One is labeling. To not give people a choice about the technology makes a lot of people nervous. They may well be thinking, "hey, this may not be good for me and I certainly don't want to just be told I'm not going to have any choice about it. To be told it's going to be in the food, you just feel good about it. But, building trust around technologies is really hard. But I really think the best thing would be to give people real choice and some real sense of participation. And that does not mean come and listen to the biotech folks tell you how great the technology is. And then when you say, "Hey I don't, I don't like this." Having them say, "you would if you understood it, if you're as smart as we are. You would really like this technology." That cannot be the conversation. But that's what many people understand the conversation to be. Rather they'd like to hear, "Hey, you've heard my concerns and maybe sometimes you'll even say, "Okay, we're not doing that. We're going to listen to you." Then people would say, "Well, you know it's not just a one-way street,"

[1:12:54]

[A.W.]: So what would you like the general public to know about genetically engineered organisms? And how would you like to, to let them know?

[M.M]: Right now in some ways, I don't care. As I said, I don't think it's a technology that whether we have it or not is going to make a difference to most people. So I'd like to know is that there are people in science who are smart, who are using their skills to come up with products that they hope will be useful. But basically genetic engineering is not an iPhone it is not going to change things very much. So how should I say this? Earlier I might have thought I want people to understand this so they can take advantage of the good stuff if it comes through and I don't want them to be unnecessarily afraid of it, which they shouldn't be. But now I just don't think it's turned out to be very important. We really wouldn't want to invest huge amounts of public resources in helping people understand it.

[B.H.]: So is that biotechnology then that's the next big thing?

[M.M]: Well, I think genetic, I'm talking about genetic engineering and transgenics primarily. Now the new stuff that's coming, the gene editing, gene drives, that kind of stuff may be different in important ways. I also think it's very complicated, but I'm always revising my opinions in terms of facts. And it may be that there be applications where you just say, this we cannot do without. But, you know, I just don't see that right now.

[A.W.]: So, what about, what would you like the general public to know about the policies concerning, genetic—

[M.M]: I'd much rather have them understand traditional breeding and agriculture and the way it really works and where the solutions really lie. So having said that I think, I don't think people ever really understand regulation to be honest. If you don't do this work, you don't understand it. There's no way that the public is going to understand regulation. They can understand the basic notion that there are regulatory bodies that are going to make decisions that are going to balance risks and benefits and that they can have confidence in those bodies. But beyond that I really don't think understanding regulation is even an issue. Trusting government is huge. Whether the public really trusts the people that are making decisions to be making ones that are good in some way.

[1:16:39]

[M.B.]: So, I have a last question, which is are there any questions you expected us to ask but we did not or what questions should we have asked?

[M.M]: I don't know. You really let me just chat on so I'm not, well... I do think all of us have a challenge in how we can enable conversations, in the context of what we're beginning to learn about how people hear and take in information. And I think that's going to be important for everybody whether one is for or against technologies. As I said about the progress frame, we now understand that, you can tell people over and over and over how dangerous something is but basically if they have in their mind that it represents progress, they don't hear any of that. They are never engaged in the

conversation. And there are lots of frames out there that determine the way information comes to us, how it is processed and whether we do anything with it. People are finding that in politics. There are all these different ways to make pitches to voters. But in the context of having conversations about technology or agriculture, we too are beginning to understand some of the subtleties of communication. God, I wish I understood it better, but I think it's going to be a challenge to all of us. How do you get people to hear what you want them to hear? And understand that we're all going using new manipulative approaches to influence one another because we won't have any other choice.

[B.H.]: Can I ask one...besides coffee what gets you out of bed every day?

[M.M]: Hmm.

[B.H.]: What motivates you?

[M.M]: Well, two things. Well, I mean, I love my *[laughs]* long-term partner, he's great, but my work has always been very important to me. I think it's really important to try to make a difference in this world to make it a better place. I have been fortunate enough to have that opportunity by doing the work I've done. And even though I'm retired now and I only work between a third and half-time, just having that opportunity to continue to work in that community, does give meaning to my life and I value it immensely. And then horseback riding *[laughs]*, which also I really love to do. I can't think of any other single thing that I could do for an hour that would make me as happy as riding my horse.

[A.W.]: Thank you.

[M.B.]: Thank you.

[M.M]: Well thank you!

[M.B.]: Thank you very much

[M.M]: I'm just so taken with the idea that somebody is going to look at this in 30 years.

[M.B.]: Let's hope!

END TRANSCRIPTION