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# **Module I Panel Discussion and Q&A Session**

**MODERATED BY NEAL VAN ALFEN**  
*University of California*  
*Davis, CA*

## **PANEL DISCUSSION**

*Eugene Rosa (Washington State University, Pullman, WA):* The first question is for Larry Busch. Your presentation was both informed and stimulating, and, as intended, highly provocative. We thank you for it. Unfortunately, it created many more questions than we could ever cover in the time here, but let me throw out at least one. You and I, as social scientists, have been looking at the glass of agricultural biotechnology water—you longer than I—and I have concluded that in the case of the United States the glass is half-full while your presentation could be interpreted as saying the glass is half-empty. In particular, you observe that public resistance to biotechnology can easily be found in the United States, whereas I see the resistance as more sporadic, unorganized, and not widespread, especially in comparison to Europe, where there is clearly a great deal of resistance to these products. What empirical evidence might we look at to resolve our differences over what, in fact, is the current level of public acceptance of, or resistance to, agricultural biotechnology in the United States, and how might we assess those data as trends on the potential for its future adoption?

*Lawrence Busch:* The long answer is a couple of books in length. The short answer is that National Science Foundation surveys show pretty much a steady concern among about a third of the population over agricultural biotechnology, as compared to about two thirds in Europe. Now, that said, there are enormous variations within those very crude numbers. If the question is: why is that less articulated in the United States than in Europe, the answer is fairly straightforward and has to do with the US governmental system and the fact that we have a presidential system with two parties tends to move all debates towards the center, wherever the center happens to be at that particular point in time, whereas, in most European countries with parliamentary systems, more factions are heard at any given point in time. It has nothing particularly to do with biotechnology. I think this is true across the board for almost all issues.

*Karla Chambers (Stahlbush Island Farms, Corvallis, OR):* I am not an academic. My husband and I farm and we have a food-processing facility. I recently spent 8 days in Tokyo talking to our customers, and that's the majority of what I do in our business—talking to customers internationally as well as domestically. We sell products throughout the United States and in fourteen export countries. So, my comments reflect that experience—spending thousands of hours with people who buy our food products. I might suggest to both of our speakers that the debate is not about science today. The scientific debate, in many ways, is past. The current discussion I'm having with my customers is on traceability, on isolation, on documentation, on how are we testing our seed corn, how are we testing our finished product, how are we creating buffer zones, and—bottom line—how am I going to guarantee them, my customers, that our products are GMO free and free from any contamination. If you don't have this traceability documentation and this testing program to guarantee them this control, then those markets will move to those players who do. My question: is science putting our US growers in conflict with our international and domestic markets and consumers? Should the scientific community try to influence the market or should the scientific community respond to markets?

*James Cook:* I would totally agree that the debate has moved beyond science. If you attend a conference of scientists anywhere in the world—Europe, Japan, North America—they will be on a completely different track from what we have here. We're looking at the next breakthroughs, and where science is going from here, with a lot of excitement. As to whether the scientific community should address the markets—I don't know the answer to that, Karla. I'm worried about scientists trying to do other than what they do best, which is to put new knowledge into the marketplace, and that knowledge is being generated as much in Japan as it is in Europe, as it is in North America. Ultimately, this knowledge will become part of the fabric of what society understands. Within the National Academy there is a huge effort looking at K–12 education, which is such a long process. I really don't think we can wait that long. We've got to find a way for the scientific community to be able to communicate better. We have been totally ineffective in getting our message out. Some scientists don't even believe that it is their job to get the message out. I will say this about the Japanese market: from what I understand, it has been more generous on tolerance limits than has the European market. But that tolerance—if a product is to be marketed as GMO free—if there is a carryover product in there, say up to 5%, then even that has to be approved by their regulatory system. A tolerance level does not apply to just any biotech product, but, in fact, to one that's been approved. So, I think there are some possibilities. At the same time, it took Washington State 20 years to begin to market apples in Japan over issues such as the codling moth, and we may be looking at a similar long-term process with respect to biotech products. I really don't know whether it's the scientist's

job to try to address the marketplace or not, but I certainly feel it's our job to put the best knowledge that there is—not that it's always without flaw, but always double-checking ourselves, and reworking our own data—to make sure that the best possible information is out there for the public to understand.

*Busch:* We are in agreement that this is not entirely about science. I would go so far as to say that science cannot do anything other than influence the marketplace. When they first invented automobiles, the people in the carriage industry were quite upset. Most of them went out of business. That's the nature of business. That said, it is important to remember that there are always far more problems that scientists can address than there are scientists available to address them. So, questions about public and private policy enter in here in terms of determining which problems people are going to work on, where is funding coming from, and who is going to do the work? Moreover I'd emphasize that even in the decisions on the part of the Japanese to determine that they want low levels, or ideally no, genetically modified organisms in their food supply, obviously that is a scientifically impossible thing to achieve, at least in areas where GM crops are grown. But, even in those areas, science is implicated because science has to design the tests, has to develop the standards, has to determine the sampling procedures, has to determine the reliability and validity of the tests. There's no way to get around it. Science is involved in all these things.

*Philip Bereano (University of Washington, Seattle, WA):* I'll combine a couple of questions. In September of this year apparently, the Cartagena Protocol on Biosafety will come into effect. It will regulate the international movement of GMOs, including those for food, feed, and processing, among those countries that sign it. The United States will not be a party to the protocol, and, presumably, will be banned by some of its provisions in terms of countries that previously took our exports. The Biosafety Protocol requires for foods a less rigorous procedure than it does for GMOs, but it recognizes, of course, that every sovereign country can decide what is required for non-foods and that's to say risk assessments will be needed. Now in the international negotiations that I've been involved in, such as of the Protocol and the Codex Alimentarius, the US delegation, including scientists, industry, and government types, constantly refer to the US regulatory system as being science-based. Those of us who are students of it and knowledgeable about it, know that this, of course, is not the case. There have been no risk assessments with publicly available information because of FDA's announcement in 1992, at the bequest of the Council on Competitiveness under the first Bush administration, that GM foods would not be regulated because they were "substantially equivalent to non-GM foods." Substantial equivalence is nothing more than the doctrine of analogy. By definition, analogous items are different as well as similar. *A priori* it was said

that the similarities outweighed the differences, without any scientific investigation of any of the GM crops under consideration. So we are heading for a confrontation if one of these countries, 1) insists on doing a risk assessment, 2) asks for the US data. This is from the *Washington Post* 2 days ago. I'll read this and then ask the speakers to comment on it:

*The FDA reviews biotech foods for safety and the agency's action on a new biotech crop is often characterized in press accounts as approval, but legally it isn't. The FDA operates a voluntary system under which biotech companies decide on their own how to test the safety of their products, submit summaries of their data—not the full data—to the FDA, and win a letter that says, in so many words, that the agency has reviewed the company's conclusion that its new products are safe and has no further questions. In most cases, the data on which the safety conclusion is based remain secret, confidential business information. It is a much less rigorous system than the FDA procedures for reviewing new drugs or food additives, in which the agency will spend months, if not years, going over company claims in detail.*

The role of science in all of this has been a bit of a sham, because the scientists are not disinterested enough to have blown the whistle on this a long time ago. Gunther Stotsky's research was published 5 years after *Bt* corn was commercialized and planted on millions of acres in this country. Is that science? In a rational, scientific, regulatory procedure, I would think—and I'm interested in your comments on it—that Stotsky's work would have been required first and then the agency, on behalf of all of us, would have made a determination on the basis of that sort of research whether the crop should be put out, because they did or did not present a risk to the environment. I believe that a short-term economic interest is driving this whole thing, and the scientists have not had the spine to stand up and blow the whistle on it.

*Cook:* In the scientific community, we have our own doubts about whether the current regulatory system is, in fact, science-based. We consistently try to put the best science on the table, fully recognizing that what comes out in the way of policy can be reflective of the politics as much as of the actual science. Now, in terms of whether we are doing the best job we can to understand potential risks to human health or to the environment, reflecting on Gunther Stotsky's work—which I think is really where this question is going—we have followed the same procedures that we have always followed, only with much more rigor since transgenics came on line. For example, we have in use today in North America wheat varieties with genes for resistance to Russian wheat aphid, genes expressed for resistance to Hessian fly, and genes expressed for resistance to green bug. What are the effects of those genes on non-target organisms? Has anybody looked? Was there a reason to look before the varieties were released,

in this case by land-grant universities? Should we have looked at the root exudates of those varieties to see what they are doing to non-target organisms? It comes back to Larry's comment: a tremendous amount of research can be done, and we can hold this technology up indefinitely. Every new variety that has been released by Washington State University ultimately revealed its weakness after it was scaled up. If it revealed any weakness before it was scaled up it was usually pulled unless there was some really important reason to push forward. The same questions could be asked about orange juice: whoever proved that it was safe? What clinical trials were done to establish its safety? If orange juice is safe coming from a tree without the citrus-canker gene would it still be safe if it came from a tree with the citrus-canker-resistance gene? The substantial equivalence model has argued that, in fact, the changes are so slight relative to what we've done all along with conventional breeding, where you can create all kinds of variation in anything you want to measure, but it is hardly worth the expense although certainly the questions can be raised. Now, I believe that, with respect to transgenic crops, there has been more intensive measurements of things that I never imagined we would have to measure—hundreds of proteins between the transgenic crop and its corresponding, non-modified, counterpart. And it's true that a lot of this is confidential business information, and I think that's unfortunate in the sense that more of it cannot be put into the public domain. I would be delighted to see it in the public domain. The National Academy of Sciences is looking at ways to bring some of it into the public domain in the same way that they publish treatises on nutritional values of feeds and so forth. But, the questions that have been raised—and there is no limit to these questions—continually fall back to the standards from which we have worked for many years. The *Pch1* gene that was put into wheat: what would it do if it were transferred to the goat-grass population? What if Orville Vogel's *Rht2* gene had transferred to the goat-grass population? Would this goat-grass have made more seeds, making it a bigger weed problem? These are issues that were not addressed, although they could have been addressed. They are being addressed with transgenics, but are still not being addressed with conventional cultivars, which we assume are safe because of years and years of experience with them.

*Busch:* Let me add a minor point. It seems to me that one of the problems we have right now with the regulatory system is that, even when we do careful risk analyses, we ask scientists to do things that they don't have any special competence to do. First, we ask scientists to determine what the risk is given what are probably relatively incomplete data. That's fair, because we need to know it now. We can't wait until all the data are in. But we also then ask the scientists to tell us whether that is a risk worth taking, and scientists have absolutely no special competency to answer that question. That's an ethical question, to which every single person has an equal ability to come up with an

answer—something has to be publicly negotiated. We do science a disservice when we have scientists trying to answer the ethical question and making a claim that somehow the question of whether a particular risk is worth taking is a scientific claim.

*Rosa:* It is now a truism in the risk literature, which is large and growing, that perceptions about risks and the willingness to incur risks are shaped as much, in some cases even more, by the qualitative features of risk than by the objective “probabilities” of undesirable outcomes. So, for example, people get quite concerned about voluntariness control, scientific knowledge, and a whole variety of issues. One such qualitative feature, the feature that is essentially of concern to people, is not so much the risk itself but who is managing the risk and, in fact, can that institution or organization be trusted. In fact, I would argue that your example, Larry, of the success of the pharmaceuticals compared to transgenics would be, in part, a function of the trust that is embedded in the medical profession, pharmaceuticals, and so forth. To what extent do you perceive that resistance to agricultural biotechnology is a function of mistrust of the institutions, and other actors and stakeholders in this scientific application, and to what extent do you see mechanisms for reversing that mistrust? By the way, as an add-on issue—I think it’s quite important—a frequent solution of these problems that occurs, and I’m sure Phil will tell you the same, over and over again in technological controversies, is the answer: educate the public. The risk information that I’ve just given typically argues against that. It tells us that that’s a fairly typically, somewhat superficial and unrealistic solution to the problem, that the problem is much deeper and has much more complicated features to it than simply getting people information or education. And the expectation is a normative one, that once they have this information they will adjust their attitudes and their perceptions to be in line with what the scientific information is.

*Busch:* Your question is hardly an easy one. It’s a tough one. Let me see if I can at least frame an answer, which I would be happy with. It seems to me, first of all, that a key issue in terms of doing any kind of risk assessment is defining what the risk is, and that is only partially a scientific issue. In fact the issue that you raised a few moments ago about how we do certain kinds of things for transgenics and we don’t do them for crops produced through conventional plant breeding is a good example of how, in the one instance, there has been a desire to frame these things in one way and in another instance to frame them quite differently. That said, of course we know that through conventional breeding we can produce instances in which toxicity to humans or environmental problems could emerge. There are examples out there. If my memory is correct, a potato plant was developed about 10 years ago that luckily never made it to the market place because the breeder himself decided to try some

and got sick. So the point is: the question of how the risk is framed in the first place is critical, and I think the problem we have here, from at least the skeptical public's point of view, is that we don't fully know how to frame risks that have to do with transgenic crops. We haven't come up with a good way of doing that. In turn then, shall we say, there's a kind of bouncing back to the question about crops in general. Are there kinds of things we ought to know? Other kinds of environmental questions? Other kinds of food-safety questions? Now, all that said, I don't see anybody out there, in either the public or the private sector, who is deliberately trying to produce something that is unsafe or will create environmental problems. I think we can, for the most part, argue that if those things occur they are the result of accidents or stupidity, or trying to move so fast that you make a fool of yourself. But it all does come back to the trust issue that Gene raised, and I think he's absolutely right. The US public, for the most part, trusts the FDA when it comes to doing tests on pharmaceutical products. We are comfortable with that. Even though the FDA has occasionally made mistakes, it has had relatively little effect on the public trust. I'll come back to the point about labeling that I made earlier. Part of the issue here is if you say "trust us, we won't even tell you if it's there," it seems to me you are asking for trouble. You are creating a situation which produces distrust. After all, I know these folks want to sell something to me. They want me to buy it, but they're not going to tell me what it is. That's a very problematic situation.

*Van Alfen:* Could we have some short questions and short answers, and then we'll turn this over to the audience?

*Chambers:* The last five investments we have made in our farming operation have been electronic and technological in nature: GPS satellite tractors, aids that will improve our efficiency of harvest of strawberries about 200%, and automated cultivators. Is it possible that we are missing or overlooking possibly the next revolution? The focus today is biotechnology where we substitute chemical inputs into the plant rather than application to the plant in many instances. Might a more powerful consumer-friendly tradeoff be technological and electronic substitution rather than chemical input? Let me ask specifically: pattern-recognition technology in exchange for herbicides could be enormously powerful in our daily farming operation and we are very close to making that happen. Would either of you have a comment on that?

*Cook:* I think these technologies are tremendous. And, as I tried to indicate at the beginning of my talk, many emerging technologies are coming together to improve the farm operation. The electronic technologies are emerging very fast, weed recognition for example. If any one of the three drivers—economics, environmental or social—fails, then a new technology will not be adopted. Could a wheat farmer afford it? Right now maybe not. But I think we are going

to need all of these. Those of us who work on the systems end and in production agriculture are constantly looking for the best combinations of tools, and if they, in fact, get the job done, then that will mean that genetic approaches in some cases will simply be redundant or irrelevant. But, I think we are going to need them all. We have a lot of crops. We have a lot of diseases and I would qualify what you said about making a plant produce its own chemical. There are compatibility aspects to deal with when we talk about rust resistance and so forth. Yes, they come down to chemicals. Our own bodies are making chemicals in our defense against pathogens, but we think of these more as compatible/incompatible than we do the pesticide made by the plant to stop the pathogen. Just wanted to clarify that.

*Busch:* The blueberry industry has a major problem in Michigan with the Japanese beetle. There's no food-safety problem here, of course, because beetles are totally edible. In fact they provide a nice source of protein apparently, but most people just don't like to eat beetles. One of the results is the development of photo-optical sorters that every blueberry passes through, which can guarantee that the industry has something close to completely zero tolerance for Japanese beetles. It's all a matter of electronics.

*Bereano:* Larry, the thrust of your remarks was summarized in the statement "it need not have been this way," and I want to focus on that and challenge it, because I think that statement ignores the realities of monopoly capitalism in the current era. Tomorrow morning when the FCC announces rules that further consolidate media control and ownership in yet a fewer number of hands, I think we'll see that the story of Monsanto going to the Reagan administration was not an aberration. It was in fact a paradigm. A paradigm of what is behind this whole technology as short-run corporate-driven. Your chart, which had your sweepers, had the consumers at the end; there was no consumer demand, in my understanding, driving this technology. This was a technology looking to create consumer demand and I would say the same to Jim who had something near the end of his talk about demands of consumers. At the UN Sustainable Development Summit in Africa, I was debating US Agency for International Development Assistant Administrator Emmy Simmons about food aid to African countries and their refusal to take the genetically engineered maize. It was a heated debate, as people might be able to imagine, which continued after the cameras stopped rolling. Simmons said to me, virtually wagging her finger under my nose, "What you don't understand is that in 4 years we will have gotten South Africa to plant enough genetically engineered crops that the pollen will have contaminated the whole continent." It's a corporate strategy. It's not adventitious contamination, it's intentional. It's a corporate strategy that the government is in cahoots with. This whole idea of feeding the world using genetically engineered crops is yet another way to contaminate the ancient land



racers and we are complicit in it. It's clear that, to those of us who study world hunger and work with peasant organizations, genetic engineering is not needed to feed the world because, in our own country where we have enormous excesses of crops, engineered and not engineered, we have millions of hungry people. Hunger is clearly a function of economics, of politics, and social factors. Genetically engineered crops are patented, which makes them even more an issue of corporate control. I think that this technology and this kind of scientific pure view of this technology is fundamentally naïve. In reality, it is a corporate-driven mechanism to increase control and profitability by a relatively small number of people using techniques, like appeals to public sympathy to feed the world, as a way to foster their control over the food supply. And I think that it "need not have been this way." It need not have been this way if people organized against it, but I'd like you to comment on that because I think that that's the way the world is working these days.

*Busch:* Well, as you say, it need not have been this way if people had organized against it. I agree of course. That's precisely the point that I wanted to make. I agree with you that the issue of hunger is largely an economic question especially in the short run. In the longer run perhaps one can make a case for increased productivity and production, but, certainly in the short run, the issue has got nothing to do with that. In fact, just a brief footnote to this: about 5 or 6 years ago I was wandering around in Mali as a part of an evaluation team of INTSORMIL, the sorghum millet collaborative research support program funded by the US Agency for International Development. I came across a farmer who had planted some new improved sorghum seeds, and he had them right alongside the ones that were not improved and the difference was astounding: two or three times as much sorghum seed on the plants. I said, "What do you think of these?" And he said, "This is absolutely fantastic seed." I said, "Well, would you buy these if you had to?" He said, "Oh of course not." And all the people who were there were shocked, because this guy was supposed to have said, "Yes of course." And I said, "Well why not?" He said, "Because there's no place to sell the surplus." And the reason there was no place to sell the surplus was because of US and European farm subsidies. It was far cheaper to buy wheat in the capital city of Bamako than it was to buy sorghum produced locally. So, these problems are exceedingly complex. They are a combination of, shall we say, corporate and government policy, and I believe they are not going to change rapidly. On the other hand, it need not have been that way.

*Cook:* First of all, it's interesting that neither Larry nor I mentioned this technology as a means to feed the world, although I think—

*Bereano:* That's why I brought it up, Jim.

*Cook:* It usually raises a red flag and it diverts the discussion. I would say that, with respect to the minor-use application that I got into, this, in itself, can make a huge difference in developing countries as is already happening with virus-resistant sweet potatoes, and so forth. But, let me back up and make another comment. I do not accept that the biotech companies and their monopolies are deliberately trying to spread pollen around. Every time we put a new variety of corn out, a new hybrid, its pollen has moved around whether from the land-grant university way back in the early days, or the hybrid seed from Pioneer or Syngenta or whoever. That pollen is going to move because it is just a natural thing. One more point: this technology has enormous potential. You can tell by my enthusiasm for it. I would say that whatever we would want to raise in the way of questions about transgenics we could just as well raise them with respect to conventionally bred cultivars. And I would also say that, if this issue is about corporate monopoly, how come it was so easy for McDonalds to get that NewLeaf™ potato back on the shelf at Monsanto? It showed that Monsanto was absolutely helpless against McDonalds and Frito-Lay, and that corporate control over farmers is not what we think it is. I might also add that the real down-in-the-trenches battle that's going on within corporations is over market share, but if you look at some of the business reports that have come back and who is making money, companies that continue to depend entirely on a pesticide market for their products are, in fact, showing little or no margin of profit, whereas those that have moved into biotechnology—although I agree that things are a bit more shaky right now—were, in fact, the ones that were making a profit. The real battle that's going on is among the multinationals in the marketplace. When Monsanto takes over 70% of the acreage on soybeans all the companies that did have a share in that market making herbicides suddenly are letting their employees go and are scaling back on their R&D. But if somebody said, like McDonalds, we're not going to take those soybeans, that'd be the end of it, the same way it was with potatoes. So, there are many checks and balances in this system.

## Q&A

*David Schmidt (International Food Informational Council, Washington, DC):* My question is for Dr. Busch regarding the survey question on labeling. You may know that our organization has commissioned eight surveys since 1997, approaching the labeling issue differently from the survey you cited. I don't think you cited the source, but I've seen similar data quoted. I'm going to describe how we go about it and then ask whether the survey you cited gives consumers enough context to elicit intelligent responses. In our most recent survey, in early April 2003, we asked the question, "Is there any information not currently included on food labels that you'd like to see added?" Some

75% of Americans could not think of anything. Others, about 7%, said, “Ingredients, nutrition information.” About 1 or 2% mentioned anything related to biotechnology. Later in the survey we actually described the FDA labeling policy, which explains no special labeling is required unless there is a change in the products composition, *etc.*, and found that 62% of Americans supported the current policy. My question is: does a question about labeling, “should genetically modified foods be labeled” give enough context for consumers? In this case you cited, I think, 92% answering in the positive.

**Busch:** First of all, let me say that the survey I was referring to is one that is on a website at North Carolina State University, Wimberley is the first author and about thirty people were involved. It is my understanding that, yes, it did provide some context. But, I think all surveys should be taken with the “lies, damn lies, and statistics” approach. Certainly the way in which you frame a question is going to affect the answers. On the other hand, plenty of other surveys have given similar results to those of Wimberley’s study. Certainly, how a question is framed is critical.

**Brewster Kneen (the Ram’s Horn, Sorrento, BC):** I would like to raise a concern in the form of a question. This discussion so far, and its framing—the whole event—is focused entirely on industrial production agriculture, essentially on monoculture. I am concerned, Professor Cook, at the emphasis on the scientific community as a monoculture. You speak of “we in the scientific community” as if there were only one science and only one scientific community. As I look around the room, I think that this is a very North American grouping here. What about the rest of the world? What about other ways of knowing? There is more than one science. I cannot accept that there is a scientific community. I think one of the problems that we face, here, is understanding that we do not represent the world’s people. We represent an elite and a small minority of the global population who do not now, and I don’t think ever will, feed themselves with industrial agriculture or biotechnology, or GPS or any of these other things, because our system is not affordable. It’s not affordable for us and it’s not affordable for the world. Do you really think that there is only a science and that we have all the answers or will have in due course?

**Cook:** Well, of course not. There is a scientific community and huge debates go on all the time within it. It’s interesting to look at the differences between where science is within this spectrum and where society is in terms of beliefs or expectations *vis-à-vis* the origin of life, human cloning, global warming, reproductive biology and so forth. This is where I was heading when I said there’s science and then there’s politics, which reflects the perceptions of lots of people and ethics and on and on, and policy comes out as a balance of those two, and I fully accept that policy will not be driven only by science. Now, as

far as developing countries are concerned, I quoted Clive James, who in the 2002 ISAAA report indicated that the majority of farmers growing *Bt* crops operate smallholdings—in China, India, Egypt, and so forth. The beauty of some of these technologies is that a single gene can be put into a popular local variety like “Meekers” raspberry to keep it healthy in the context of how local farmers prefer to grow it. Industrial agriculture has its own baggage. Personally, I don’t think, even in eastern Washington state, I’m working in what would be called industrial agriculture. You might call it that, but I’m working with family farm businesses that are large in order to stay in business. As I go around the world, farmers ask the same question: “How can I control this disease? I did everything right and still got it.” That’s where the genetic approach—including through the international centers—has been able to deliver solutions to these problems case by case, one by one, to the benefit of local farmers. So, if I gave the impression that all scientists are of a like mind, believe me that is not what I intended. The scientific community is debating within itself on all of the issues I just mentioned, but making progress all the time. At one time there was disagreement as to whether the sun went around the earth or the earth went around the sun. Society believed one thing, Galileo and his followers believed something else, and it took a long time before the two came together. We don’t even think about that any more. We have to allow all of this discussion and all of the process to work. I am not here to say we should speed this thing up and short circuit it. We must allow the process to work. Everybody in this room has a legitimate stake in this issue and has the right to be heard.

*Gabrielle Roesch (Western Washington University, Bellingham, WA):* My question has to do with what was said in terms of not knowing how to fully frame the risks associated with biotechnology. If we are not aware of how to frame the social, environmental, cultural, political, or economic risks, I’m curious as to how we can justify continuing at full force to commercialize more and more biotech crops and to spread the technology throughout the world.

*Busch:* If you look at how all risk questions are framed, both science and politics are involved. We have probably jumped ahead of the game on biotech crops, in the sense of not checking certain environmental risks out more carefully. That’s my personal view. Others will disagree. But, you can see the same problem even in areas that are well established. For example, the United States and France test cheese for *Listeria* and the US bans unpasteurized cheeses that are less than, if my memory is correct, 60 days old. In contrast, France does not. Now the data are the same, and one of the interesting ironies is that more cases of listeriosis are associated with US cheese than with French cheese on a *per capita* consumption basis. The risk is relatively well framed, the data are not really in dispute, yet the public policies differ radically. Although there is no such thing as a risk-free world, one has to be careful with technologies

that are radically new, and it seems to me that some of the biotechnologies *are* radically new, others are not.

**Cook:** I haven't thought much about the science of risk assessment, which is where the question is coming from. Within the US regulatory system, the USDA has oversight to assess environmental risks and fill in the blanks. If a gene intended for pest control is moved from one barley to another by genetic engineering, EPA has to ultimately approve that variety for commercial use. The FDA would look at that barley and say, "Well it's still barley and it's still the same gene that was previously moved by a traditional method, so we will not go any further, we will say that it is substantially equivalent." Thomas Edison had to go up against the gas industry in order to introduce the light bulb. Could we have projected that his light bulb would have led to huge demands for electrical energy including coal-fired plants that dump carbon dioxide in the atmosphere, dams on our rivers that would affect salmon, and nuclear power plants that would carry all kinds of risks? Would you vote today that we not go forward with electricity based on what you know in hindsight? And we can go over and over this with the airplane, with the automobile, with manufacturing, with recycling of wastes. Agriculture has done a tremendous job in providing a safe food supply for the American people, moving evermore into environmentally-friendly methods of production, and, yes, you can always look ahead and say, "But, you didn't answer this question." Where do we draw the line? Let's go forward. A tremendous amount of work was done before we began to move into the field. I served with Europeans, North Americans, Australians and Japanese on a task forces that looked at the science that countries would use to develop their own regulations. We had a tremendous amount of debate on this, but, in the end, we said, "It's time to scale up. We've got the bases covered." Yes, there will be questions. I don't think you should worry that much about framing all of the risks because we've done everything we can and the benefits are just so great that it's time that we try it.

**Elliott Peacock (University of Washington, Seattle, WA):** You showed impressive data and pictures of substantially improved crops and it makes a lot of sense to apply biotechnology to agriculture from an economic standpoint. But we live in a democracy and this technology will affect different people in different ways, not just in this country but also in the world at large. What political, social and cultural considerations should be part of the decision-making process? Who should be involved in that decision-making—is it part of our responsibility?

**Busch:** Do you want the 2-hour answer or just the 30-minute? The industrial democracies of the world have failed to democratize science and technology. We have assumed that science and technology are essentially ethically neutral with respect to the rest of the world and, therefore, are not subjects of concern for

democratic governments. I would argue that we need to address that. I would argue that NABC haltingly moves in that direction. I suspect that Ralph Hardy would agree with me. But we have not come up with satisfactory means for dealing with technological changes that have sweeping distributive effects and that might infringe on the rights and obligations of various citizens. I think this is a critical issue and it's one we have tended to try to brush under the rug. For a variety of reasons, biotechnology is one of a few areas in which there has been a lot of noise, yet we have still not come up with some good mechanisms, and I'm talking here about organizations and institutions to allow us to adequately address those questions.

*Cook:* We are using the terms “science” and “technology” interchangeably. Science says, “Hey, it's the earth that goes around the sun. Genes do this. The human genetic code is that.” Technology then takes advantage of knowledge to develop new tools, like the light bulb and electronics and, of course, genetically modified crops. Each new technology carries with it a certain amount of resistance because someone is adversely affected by it. The internal combustion engine had a huge impact on the horse-carriage industry, for example. Biotechnology brings with it many changes. Providers of fungicides right here in the northwest may go out of business or have to find new ways to make a living. That is how technology leads to change. But science is the knowledge base that we should all embrace to bring the eyes and ears of society to how things work in nature.

*Busch:* I would argue precisely the opposite—that a distinction between science and technology is no longer tenable. Any distinction is more conceptual than practical. If research geneticists were totally disconnected from the people who actually applied the genetics then the position you took would be correct. But, they are not disinterested. The scientists are involved in a variety of ways—from being part owners of companies to receiving grants from companies to wanting to make a difference. It's perfectly reasonable for someone such as yourself to want to make a difference in agriculture. I presume that's one of the motivations that got you into science in the first place. So, it seems to me that a sharp distinction between science and technology simply doesn't exist.

*Cook:* But, there still is a distinction. You are right that they are blending, but more so in medicine than in agriculture. Yet we have great comfort with medicine and not with agriculture.

*Cathleen Kneen (The Ram's Horn, Sorrento, BC):* My question follows from Brewster's. Dr. Busch, I suspect I was not the only person who felt a little uncomfortable at the slide you showed on the dissemination model with an arrow going in one direction. That doesn't describe my understanding of where

innovation in agriculture comes from nor, in fact, does it describe my understanding of the appropriate relationship between the farmer and the scientist. I'd like to have you comment on that. I assume that this was a slip of the tongue or a slip of the pen on your part and that, in fact, you would agree that that doesn't describe the model accurately. If not, could you say a few words about how then you approach genetic engineering, which itself is clearly not something that has been developed by farmers working in the fields, to try, as they have for millennia, to deal in a creative and sustainable way with the challenges that Mother Nature throws in their faces.

*Busch:* There are two separate—maybe not entirely separate—questions there. First, of course, I was not arguing in favor of that diffusion model. I was simply saying that many people believe that it is a very nice unidirectional model. In fairness to some of the people who have worked on this, there is often an arrow going in the other direction, usually labeled feedback, which is an interesting term since in engineering it usually means “squeal.” I wear hearing aids, and every so often I get feedback and it's not something that I want. The problem, and in fact the reason that the term feedback is used in that model is because it's a one-way communication. It's, “Here, I have this particular thing, do you like it? Oh you don't, I'll try again. I have this thing do you like that? Oh, you don't.” And you keep working until you find the thing that somebody wants. It's a very, very inefficient means of innovation. That said, let me move to the second part of your question. Innovation can originate at any part of the supply chain. Look at the invention of frozen foods, which are enormously convenient. You could argue, certainly, that fresh foods are better than frozen ones and I wouldn't disagree. But I would probably argue that frozen ones taste better than canned ones and so on down the line. The point is, innovation and invention can occur at any point in the supply chain between the input supplier and the producer. What I think has happened to agriculture over the last couple of hundred years, with both positives and negatives, is that things that used to take place on the farm now take place elsewhere and a lot of things that used to be farm-based processes are now industrial processes. A group of geographers in California, Goodman, Sorj and Wilkinson, wrote a book on this and argued that two things have been going on: substitution on one hand—we substitute say margarine for butter—and appropriation on the other—instead of producing butter on the farm we produce it in a dairy. We live in a highly industrial society and are probably going to wind up with a wide range of ways in which products move between producers and consumers. I'm not sure I like all of them, but that's partially in the nature of the beast. Now this comes back to the point that Phil Bereano raised earlier about corporate control. Actually, I would argue that, if there is concern about corporate control, it should be focused at the downstream end in terms of the shift in power in the food system away from input suppliers and processors to supermarket chains. As I

mentioned, three supermarket chains now dominate worldwide, Wal-Mart, Carrefour and Ahold. It is interesting, however, that the nice simple suggestion that these are three evil giants actually tends not to make much sense. When you look at what is going on, you discover that these three giants are sensitive to all sorts of issues having to do with the public, and they trip over each other in many, many ways, Wal-Mart perhaps less so than Carrefour and Ahold. But, they trip over each other in many ways in order to respond to rather slight shifts in the public's view of them, because they are paranoid that they are going to lose one or two percent of their market share. So, I'm not sure I know where this is going. I do know that it's definitely not the world of 50 years ago or certainly not the world of 100 years ago.

*John Browne (Judd Creek Nursery, Burton, WA):* I'm a local horticulturist. I figured that in a room full of scientists I might get an answer to, "At what proximity to Washington DC does politics trump science?" But I haven't heard it yet. I heard earlier redundant, irrelevant systems mentioned and I was thinking that they will maybe go away. I also remember technologies that we developed that we didn't use. I was in high school when Atoms for Peace, in the Eisenhower years, was proposed as a super way of excavating. In any event, if scientists don't bear the burden of ethical decisions and one doesn't choose to leave it to politicians, isn't it paramount that as much truth in labeling as possible be provided to the ultimate consumer so that we can make our own ethical decisions? What you are dealing with isn't simply something that affects the genus and species that is providing it, but a wealth of other organisms that actually have no political base. Some of them may have an economic base, but that's in the eye of the beholder.

*Van Alfen:* Do you have a question?

*Browne:* That's it.

*Cook:* I'm not sure what the question was. It would be uncharitable to leave this room today thinking that scientists aren't conscientious about what's going to be done with the knowledge base that they put in place. In fact, they are constantly in a checks-and-balance system within the scientific community through the peer-review process and so forth. At what distance from Washington DC does politics trump science? Well it happens a lot. But, we in the scientific community understand that we put the best science out knowing that it's not perfect but it's as far as we've gone, and then the policies are decided, whether it be on human cloning, reproductive cloning, whether it be on global warming issues, or what have you, including GM foods. Society has a huge stake in this and society has called the shots over and over again—not science. We put the best knowledge out there. A lot of times we more thoroughly



explain something that was already accepted but nobody knew how it worked, which results in the development of new applications.

*Eric Sachs (Monsanto Company, St. Louis, MO):* A lot of what we have been talking about today is perception versus reality. I'm hearing a lot about concerns from the speakers. I'm hearing concerns from some that have come to this microphone. What are the sources of these concerns and should we stop moving forward. Should we address those concerns and, if so, how?

*Cook:* Absolutely, we need to address the concerns and they are legitimate concerns. Things are moving fast and it is a little scary. I can understand that. There are other areas of my life where things are moving fast that I don't understand, and I might be in the same boat that some of you are here asking me as a scientist to comment. Where I do get frustrated is when I run into misinformation like, "They're putting chicken genes into my wheat." That's not an exact example, but you've heard similar statements. The human genome initiative has revealed that we humans already have about 250 microbe genes in our genetic code. We've worked really hard to address concerns over safety. One issue had to do with, "Well you're going to put this antibiotic resistance gene into my food," so we took that marker system out of the tool box. I could give other examples of where the scientific community has backed away from something. We said, "Would you accept it if we did this?" To which some said, "You don't understand. We just don't want it." How do we go forward from that? I believe we have to go forward and we have to listen to concerns. There are huge social concerns, most of which are in terms of, "How will this affect me personally?" I had a person say to me, "I wouldn't mind having my dog genetically engineered if I could win a championship with him." That's a true example. And I thought, "Yeah, it's got to come down to personal benefits." I believe, though, that most of the public would be supportive of farmers doing things that are making their life easier, making it easier to combine their corn, giving them more time with their families. I believe that society would accept that. For the most part, agriculture has got a dirty name. How did that happen? And genetic engineering is getting caught up in that baggage. We have a huge job to do, and most of my colleagues don't even think it's their job because they are so busy writing their proposals and teaching their courses. I think we can all relate to that. But you raise a very good question. We have to go forward. If we stop—and I know there are people in this room who think we are just going to stop—we're not even going to let WSU move that gene from one barley to another by the engineering method because it's just downhill from there. I hope the rest of this meeting will give us more information on how to answer that question.