Panel Discussion

Scott Barrett: All right. Well, the microphones are switched on here, and at this point we're going a chat, a public chat among ourselves about the issues that were just discussed, and then after we've had this chat we'll open up for questions from the floor. I think at least Dan Schrag wants to make a comment. Did I hear you correctly? And Klaus as well.

Klaus Lackner: Having listened to your arguments, I would say it's absolutely central to have these incentives in there, and I agree with you, you may not understand or predict the trajectory how reductions phase in, but if the incentive is there, it happens, and I can take the air extraction as an example. It cannot work unless somebody gets paid for it. But by the same token if you manage to build an industry which has suddenly as its business core the idea of collecting CO₂ and putting it away, either to sell it in the short term in enhanced oil recovery and coal-bed methane, or later to safely sequester it, that industry will go out and lobby and will say, "Look, you should tighten the standards. We want more of that because we have a business in there." If on the other hand you leave it to regulatory rules which say you must deal with the problem inside your own plant, then you will always view it as a drag on your system and consequently try to get out of it by putting political pressure on the system not to regulate you.

Geoffrey Heal: That's absolutely right. A good example of that is what happened with the 1990 amendments to the Clean Air Act, which ironically were enacted by Bush One and were a very effective piece of environmental legislation. And did exactly that—they put clear financial incentives in place for reducing SO₂ emissions without specifying how it had to be done, and leaving it to corporations to develop new technologies, which they've done on a large scale and the costs of that have come down enormously.

Klaus Lackner: And you can see it in the new plant concepts, which are being bandied around right now. If you have it driven by the regulatory side, where you gave the old plants, grandfathered them in as an exception, now anything which sits in the same place is considered an old plant. And it was just the natural driver which happens as soon as you open that door.
**Geoffrey Heal:** No, we need to tilt the playing field economically in the direction of cutting back emissions. What I was saying is we need to tilt the playing field economically so it is much more oriented in favor of reducing emissions of greenhouse gases. And I've just given the example what happened with the emission of SO$_2$ as a result of the 1990 amendments to the Clean Air Act, enacted by our present president's father, somewhat ironically I think, which in fact had a very big impact on the emission of SO$_2$ and encouraged people to develop radically new technologies for controlling SO$_2$ emissions.

**Daniel Schrag:** I want to come to the point you made about Kyoto. I mentioned it briefly in my conclusion. I agree with you on all the deficiencies of Kyoto and certainly Kyoto, if we were to plot it on the carbon scale that I showed, does almost nothing. It's almost irrelevant to the future, except that maybe it puts some economic incentives in place to begin to invest in other alternatives. And in all the public talks I've given over the last several years, I've bashed Kyoto for all the problems it has. And last week Vice President Gore actually came and taught my class at Harvard and spent two hours with the students, and they asked him, they just heard economists and technologists and myself bashing Kyoto for the previous week and they gave him a hard . . . the students really gave Gore a hard time about Kyoto. And he, I think, was very eloquent and said, "Look, you know, you go try to convince China to sign onto a treaty, think about what diplomacy and negotiation is really about, and try to get an agreement out of all these different countries. And this is what we could get. The whole thing almost fell through. It's amazing that we came away with anything." And I'm not sure that's a complete defense for anything, but I think we have to be very careful to undermine some kind of agreement because it's not perfect. That's the nature of world politics. I mean it's actually remarkable when the world agrees to anything. In that context I think it comes back to thinking about what's really missing from this discussion, which is leadership which we're sorely lacking right now. If what . . . if solving this problem requires global action, as we've just heard, U.S. influence and diplomacy is . . . I haven't . . . I'm not that old, so I don't remember when it was really profound, but I've got to say I can't imagine us having any less influence in the world given how powerful and rich we are. It just seems really out of proportion. I think we have a profound lack of leadership here, and that's really at the core of what we're talking about.

**Scott Barrett:** If I could comment on some of this. We are definitely lacking leadership, but I think Geoff Heal is exactly right that, like it or not, big things don't change in the world without the United States behind it. And we do need, it's kind of a necessary condition at the least, to get the United States to take this issue seriously, to show leadership. My view about the Kyoto Protocol, this is an incredibly complicated problem. I mean not only is the science complicated, it's overwhelmingly complicated, but the economics, the politics, the international relations aspects of how to put together a treaty that's going to actually change behavior, it's incredibly complicated. And I look at the Kyoto experience as being at
the very minimum a learning experience because we've been sort of groping and feeling our way about how actually to deal with this problem. It's not easy. One thing I think to have in mind is that this is not the first time we've done that. There are other complicated problems we've tried to address, and we've had similar experiences. The one that I find the most interesting to hold up against Kyoto is an agreement to reduce the release, the deliberate release, of crude oil in the high seas, which is a problem dating back over a century ago, and countries started to actually negotiate agreements on how to address this problem beginning in the 1920s, believe it or not. Well an agreement was finally negotiated, which had sort of similarities to the Kyoto Protocol in the 1960s, and it never went anywhere. It never entered into force, it didn't attract strong support. And then what countries did is they kind of reorganized, and they came up with a totally different approach to address exactly the same problem. The original approach was to focus on restricting, setting quantitative limits on the amount that could be released into the seas in certain zones over certain periods of time, so it's a kind of a quantitative approach, very similar to the way that Kyoto is structured. The new regime that was developed in the early 1970s was to focus instead on a technology, and the technology was to segregate the ballast water in the ships, the oil tankers, from the cargo holds that were holding the oil so there was no mixture between the two. This changed absolutely everything because it was very easy to verify whether a ship had been in compliance with this regulation, and you had these positive feedbacks that I mentioned earlier, that Geoff was really also mentioning in his talk, that the more the countries adopted this kind of technology and restricted entry into their ports of ships, tankers, that didn't comply with that technology, the more that others want to adopt exactly the same technology. Well today you've got 97 percent of global world tonnage in this treaty, and it's been an extremely effective treaty. Compliance, by the way, is 100 percent. So I think we need to . . . it's not that we should dismiss Kyoto as being not serious, I think the people negotiating Kyoto were extremely serious, but it's a difficult problem, and it's not necessarily the case that our first crack at it is going to be right. We've made mistakes before and I think we just need to learn from those mistakes.

Klaus Lackner: Let me just a comment in as a harmless engineer. If you look at the problem, you are going to avoid one ton of a CO₂ at a time, and that is a local problem. So yes, I do think we need these international treaties and these international agreements, but we could in the State of New York, in New Jersey, on the U.S. scale, decide to put the right incentives into place. We could tilt the playing field in the right direction, and we could not make it so dramatic that our economic disadvantages are horrendous. We could have a cap and trade with a pretty lax cap to begin with, with an understanding we will tighten it. But if we don't lead in that way, and say we go forward, we actually develop technology, we actually put it in place, we will never get anywhere and it is much easier to get a small group with a more homogeneous interest to sit down and say we can agree locally to make this happen. And as long as you don't push so far that your disadvantage is so large that you can't handle it anymore, you can make the first step, and you can then wait for the others to come on line. And if you look at the
developing countries, an obvious observation is we are putting out far, far more. If we all were to meet at 3 tons per person in the middle, they have a long way to grow on average. And so we have to make the first step in many ways, and we can do that by organizing things locally. It does not all have to happen on an international scale.

**Daniel Schrag:** You know the engineering perspective is an important one. I think it also points to a . . . in some ways I think a poor framing of this problem. Many of us . . . many people talk about climate change and demonize the oil industry or demonize the coal industry. And the irony is that if you're serious about sequestering carbon in any of the ways that you talked about, the industry that has the most technical knowledge about how to pipe gas around in vast quantities and then inject it in the ground, the only industry that really knows how to do that is the oil and gas industry. And moreover they're one of the few industries that has the capital to actually put infrastructure in, unless we decide to have another, like a highway program for putting an infrastructure for sequestration. And so we have to sort of redefine this problem where the oil companies aren't necessarily the bad guys. They've behaved badly, some of them at least have behaved badly, but we need to get them involved because they ultimately have to see this as a business opportunity.

**Scott Barrett:** And one thing there is that that experience of the ozone problem that I mentioned before . . . one of the interesting features of that was that the would-be losers from controls on chlorofluorocarbons also saw that they could be the winners. In other words they had a competitive advantage, certain advantage, in wanting to develop the new kinds of technologies, and we really do need to think about this not just from the scientific point of view, but we want somebody to actually change, feel your way about how you actually can get kind of coalitions on board that will be in favor of doing something while at the same time muting the dissident voices on this issue.

**Klaus Lackner:** One of the reasons I'm pursuing the mineral sequestration is precisely that. I don't think this is the technology of choice in the immediate future because underground sequestration, underground injection, and wind energy are probably cheaper in the short term. But if you can go to the industry and say, "Look, you can compete on that playing field, and you don't have to phase out, you may end up being at a competitive disadvantage if you don't get your act together, but you could well keep playing," I think you have a much stronger message to go out and say, "Look, this can be done," than if you tell them first you have to sequester and then within fifty years we have to phase out.

**Geoffrey Heal:** I think Dan is absolutely right that we have to work hard to bring the auto, oil, and energy industries on board here. They have to solve the problem ultimately. We as individuals don't. And we have to show them that their business is not going to be destroyed in that process and that their responsibilities to their
shareholders are not going to be incompatible with taking the kinds of measures the society needs.

**Question 1: Choice of Technology**

**John Mutter:** I'd like to congratulate Scott and these panelists for staying on time, for having a discussion among panel members and allowing enough time for the audience that I'm sure has questions to participate. We have the best part of 15 minutes in which the audience can engage. Please do as before: identify yourself, the organization you work for. If you have a question for one of the panelists please say so, but I don't think that's required, you can ask a general question and perhaps one or more of them will pick it up. So beginning on this.

**Man:** Michael Bobker from the Association of Energy Engineers and also affiliated with the New York Academy of Sciences. And my question really is for the whole panel and is really about the choice of technology. It seems that sequestration is very attractive. It offers very positive horizon on energy usage in our society and globally for developing countries. I have two questions about it. The first is with respect to time frame of deployment, what's realistic? As we saw from Dr. Schrag's curves, a delayed deployment of sequestration is really not much of a solution. It's very time sensitive because of the momentums involved. So that seems to me a critical question to discuss. And the second question is how the choice of a technology affects the other technologies. We heard from Eileen Claussen this morning about needing a diverse portfolio, but really we try to choose single modes of production by and large. And I wonder if we focus on sequestration, what impact does that have on the perhaps closer term investment while we wait? What impact do we have on nearer term investments in efficiency and renewables that really don't have the vested interest, don't have the power of the major industries behind them? Those are my questions. Thank you.

**Klaus Lackner:** First let me say while I'm working on mineral sequestration and carbon sequestration in general, I do think there's a difference between saying we will end up with one or two technologies which solve the problem and that we want a portfolio of options. I think we definitely need a portfolio of options. I personally picked this one to work on because I feel it's really neglected, and we create a real problem if we have to pull the rug out under this big industry. So I felt this is a necessary ingredient, but I'm realistic enough that I'm agnostic who will be the big player in 2070. I think that's the beauty of the market. All I can do is open doors and say, "Look, this is a way for fossil to stay in the game, and it's important that we have that door open." But at the same time we have to open the other doors. Now you say, "Well, resources are always limited." I would argue we have taken a point of view over the last thirty years that energy is something we have well in hand. There is no big national program in building cars because the car companies have that in hand. We had a similar attitude to energy, but if you think about it, we don't know how to provide sufficient energy for ten billion people without creating
environmental havoc. So we have to treat this problem differently and at a much, much bigger scale than we have in the past.

**Daniel Schrag:** I will also just add that the different parts of sequestration can be done differently. There may some very small investments we can make now that will be very important for the future. And what I'm thinking about is coal burning in China, which to me is really one of the huge motivations for thinking about carbon sequestration. The investments right now, encouraging China to build coal gasification plants which create a concentrated stream of CO_2_ as opposed to pulverized-coal plants, that difference . . . we're not talking about transporting the CO_2_ or pumping it into the ground, so there's no sequestration involved, but at least you allow the future opportunity for capture and storage. So that choice of technology today might allow sequestration in ten or twenty years, and remember these power plants last for forty or fifty years, maybe even longer in China. So again there's some very short-term decisions that we need to make. The sequestration doesn't need to be put together. There are little bits of it that we can do right now.

**Geoffrey Heal:** We ought to emphasize Dan's point about the time lags involved here. I mean even if we want things to happen in 2030, 2040, we actually have to start doing them today because it typically takes five years to build a power plant, and once it's built it may last for thirty or forty years. So what we're building today can be impacting CO_2_ emissions in 2040, even 2050, if they prove particularly durable. So we need to get the playing field, as I was saying, tilted and tilted in the right direction quickly, and then things will actually start running downhill. Once we've got the playing field tilted, and they'll run downhill in the right direction if we put the right tilt on it.

**Klaus Lackner:** [Inaudible] this growth at 5 percent a year in carbon reductions and the problem will solve itself.

**Question 2: Nuclear Energy**

**John Mutter:** A question on this side.

**Man:** My name is John Cummings, and I want to applaud all of you for your comments today, I thank you. And you mentioned a lack of leadership, which of course is appalling at this point in time, but I'd also like to ask each of you when we were running Russia headlong into nuclear energy, with some notable exceptions, there was very little said by the scientific and academic community about the downside to this. And I would like to know how you gentlemen feel about nuclear energy in light of your topic. Thank you.

**Scott Barrett:** Just a quick response to that. I'm not going to tackle the whole nuclear issue. But what I would say is that we do tend to think about the consequences of climate change. We should, there's no question about that. Doing
something about climate change, however, also has consequences, and we need to think about that as well. There may be environmental consequences associated with it. And the choices we make about how we move forward basically involve trade-offs, not only in terms of money but also in terms of risk. And the risk is not only on the side of what happens if we don't do something about climate change, but there may also be a risk on the other side about the nature of our response. And my only comment really is to say that we should be consistent and address both the issue of the cost, but also the risk on both sides.

**Klaus Lackner:** Some ten years ago, I decided to look at sequestration, and my first check was that I believe that I can convince myself that I can be cheaper than nuclear energy. So I feel nuclear energy is too expensive, and in my mind the biggest risk is the proliferation risk. Now five years ago people would've said otherwise, but we have demonstrated in the last few years that there are countries who start with their commercial nuclear power plants to go into nuclear weapons.

**Geoffrey Heal:** Can I just add to that that I think I totally agree with that last point that Klaus is making. The biggest single risk associated with nuclear power is just proliferation. If you imagine really widespread use of nuclear power stations all over the world then the proliferation of nuclear weapons is almost an inevitable consequence, and in the present international climate I find that a horrifying thought, frankly.

**Daniel Schrag:** Even within China, though, even within China where China already has nuclear weapons, why doesn't China just build massive nuclear and solve the climate problem? It's too expensive. They're actually planning on increasing I think their nuclear capacity by a factor . . . I hope I don't get this wrong . . . I think it's a factor of ten over the next thirty years, which many engineers don't think they'll be able to do it. And it'll grow from something like 6 percent of their energy capacity to 15 percent. It's still not going to solve China's energy needs. Their growth is so high that nuclear isn't the answer for them.

**Question 3: Decision Making Under Risk**

**Man:** My name is Paul Thompson. I'm a health economist by training and a retired Wall Street professional. Talking about risk is exactly where my question is. Portfolio managers do take a lot of risk based on a very limited amount of information. But if they make a bad decision, they're able to get out of it and sell what they bought. The twin problems of catastrophe and costs of following the path to a stable climate make decision making under risk a very different thing, it seems to me, in this area. I direct this primarily to Professor Heal, but anybody can comment on that.

**Geoffrey Heal:** Yes, you're right, portfolio managers can dump their mistakes. Venture capitalists can't, private equity investors can't, that's probably a better . . . you know, you're locked in there for good or evil, so those are better analogies.
probably. The fact that the decisions are effectively irreversible over a significant period of time does give another dimension to this, yes absolutely. It effectively gives you a . . . there's an option-value calculation that you need to take into account associated with this, and this is probably not the forum to discuss exactly how you'd formulate that option value calculation, but if you've been in the business you can see where it's coming in intuitively I guess.

**Question 4: Investment Incentives and Universities**

**Woman:** Carlotta [inaudible] research analyst [inaudible]. The panel has mentioned the need to put the right financial incentives in place to encourage corporate change behavior and also the lack of leadership. So I was wondering do you think that universities can also take the leadership in paying more attention to the way that they're investing their endowments, for example, trying to make or to buy stocks and to invest in companies that have relatively more sophisticated carbon-management strategies in place, do you think that will be helpful? I was wondering if you think that universities can help facilitate the process in terms of providing financial incentives by the way they choose to invest their own money?

**Geoffrey Heal:** That's an interesting question. It's much . . . we much debated on university campuses, and it goes back to the whole issue of disinvestment from South Africa, which was such a hot topic back in the 1980s. So the question would be asked here is whether we think universities should use the leverage they have for their quite significant portfolios to try and move funds away from companies that are negative in the climate dimension and towards companies that are positive on climate-related issues? In principle that's an attractive idea. As an economist in a business school what I have to say on that is that it's not unfortunately clear to me that the movement of funds in this sort of way, through the socially responsible investment movement, actually has much impact on corporate performance. There's a lot of studies of what this does for your rate of return as an investor. There's relatively few studies on what it does on the behavior of the corporations. And on most of those that there have been suggests it doesn't have a huge amount of leverage. Maybe that's going to change as more and more of the big pension funds get involved, but I suspect that Columbia on its own doesn't have enough impact in these markets to have a big effect. But I'm certainly mildly positive about the idea, but I don't think it's going to have . . . I think a lot of people rather oversell what this type of thing can do for us.

**Daniel Schrag:** Divestment from South Africa was the political issue when I was in college. And there were Sullivan Principles. The Sullivan Principles were very clear and were a guideline, and you could say that either you followed the Sullivan Principles or you didn't as a company. It's not so clear what that should be for climate. I'm not sure how to evaluate an oil company or a technology company on whether they're pro- or anti-climate. It's not clear we have those sort of standards, so I don't know how that would work so well.
Woman: One clarification. In terms of South Africa, maybe that was more related to negative screening which basically will inflate a portfolio management, will reduce diversification sectors as some investors do currently with tobacco companies or nuclear weapons. But what I'm suggesting is you can incorporate those criteria and take the leadership even within any particular sector, just identifying what are the companies that have more sophisticated management in terms of carbon strategies but not exclude any of the companies, for example, in the energy sector. You don't need to exclude any industry in particular, just identify companies that will be left in a better position to address the risk.

Daniel Schrag: I'd settle for any kind of student activism and agitation. I don't think we have anything like that today.

Woman: But the key point here is not activism, it makes economic sense.

Daniel Schrag: I just don't see much of it these days.

Question 5: A Hydrogen Economy

John Mutter: I think we can take questions for those people already standing, but please nobody else. Maybe that's even too many. One on this side.

Man: Ross Benson. I'm a recent graduate from MIT. This is a question for Dr. Lackner. This is about . . . you brought up hydrogen economy, and I was wondering how a hydrogen economy is actually going to be feasible given that we don't have enough platinum, which is a required material for hydrogen economy in the first place, even with the technology improvement to decrease platinum loading?

Klaus Lackner: I would argue you are asking wrong person because I'm quite skeptical that we will go to hydrogen in cars and move to a hydrogen economy. One of the reasons I'm interested in the extraction of CO₂ from air is that it allows us to avoid to get there.

Question 6: Redeploying Subsidies

Man: My name is Greg Landel I'm a graduate student in Dr. Lackner's department. My question is to Geoffrey Heal. It seems to me like the need for new technology which everybody seems to be acknowledging here would provide a huge opportunity for massive subsidies to the oil and gas industries, which are such friends of our current administration. And so the question is two ways. First why have they not taken up the opportunity to do this, starting some sort of a pilot program, if you will, for clean energy and reducing CO₂ emissions, and second given that the oil industry already is the recipient of massive subsidies in the form of wars in Iraq or various different things that we do for them, and that there are a lot of people who dislike the oil industries in part because of these massive
subsidies that they get, how do we then include the oil and gas industry and the auto industry, etcetera, into Kyoto and into changing their ways without lavishing more money on them than we already have?

**Geoffrey Heal:** There were several parts to the question. The first part asked me to explain the current administration's policies. I'm afraid I frankly can't do that. I don't know whether I can put myself inside the mind of the current administration. It's too alien a beast as far as I'm concerned. So let me deal with the second issue. It's a question of redepolying the subsidies, and currently there are, as you say, significant subsidies of various types going into the energy industries. What I really meant when I talked about tilting the playing field in a different direction was using the subsidies that we have at the moment in more effective ways and more focusing them on the problems we really want solved, including this particular problem here. At the moment there are a series of rather indiscriminate historically determined subsidies going to most of these industries. We need to collect those together, point them in the right direction, and they may be quite adequate or they may need some supplementing. But at the moment, as I said, they're there more by historical accident than by economic intention, the nature of the subsidies that are being received.

**Question 7: Renewable Fossil Energies**

**Man:** A question for Professor Lackner also about the hydrogen cycle slide you put up, so maybe you don't feel comfortable answering it, but [in] the slide you showed, the hydrogen cycle implied a non-remitting and renewable method for hydrogen extraction, and then right afterwards you introduced some sort of a reprocessing cycle for CO₂ that, at least from what I saw, yields no net sequestering of CO₂, so why would you introduce that second loop in that I could only imagine would introduce inefficiency in the energy production?

**Klaus Lackner:** The idea behind it is to make the point that technologies which you start introducing for the purposes of carbon capture and disposal can also move on into a future energy economy where you have renewable energy. I want to make the point that renewable and fossil energies are not mutually exclusive; like hydrogen can be the exchange, the currency of exchange, for energy, so can be carbon. And the advantage of going that route is we can do that without upending the existing infrastructure. So yes there is a certain inefficiency, but if you have to store hydrogen on board of a vehicle, you have at least a comparable inefficiency, and as things move forward I'm not arguing that we are wedded to internal-combustion energy. Fuel-cell technology could work with carbon just as well as it can with hydrogen.

**Question 8: Impacts of CO₂ Sequestration**

**Man:** Hi, my name is Jeremy Barth. Carbon sequestration sounds like a very promising technology, but it seems to me it's being invoked as a talisman that's
going to solve many problems without creating others. And I'm wondering if perhaps Dr. Lackner or anyone else could address the question of the environmental impact, the side effects. Just as with nuclear technology, there's the question of the long-term storage of the waste. Could you just address the question of what is the impact of storing Lake Michigan—sized body of liquid CO₂ in the Earth? It has to have some consequences. Thank you.

Klaus Lackner: I think it would be foolish to assume that any technology has zero impact. I think as you alluded earlier we have to compare the risks of different options. Now we have a pretty good idea what the risks are of putting CO₂ into the atmosphere. My argument is sort of as a guiding principle, and that's why I ended up with the mineral sequestration, as ultimately you want to put things away in the most benign possible form, which is a thermodynamic ground state usually. But don't kid yourself, this is a big mining operation, which is implied by that, and that's a big effort. And it is as big as what we are doing on the other hand, we do something comparable in order to have coal and in order to have oil and gas already, but we have to find out where the optimum in that space is too, and that implicitly brings in energy conservation. And I also would argue if you go long enough you will run into the next problem; as things grow by another order of magnitude, we will start worrying about things we haven't worried about. But yes, there are environmental impacts, but I could speak an hour on those.

Question 9: Increasing Public Awareness

Woman: I'm Vivian Gornitz from the Goddard Institute for Space Studies, and my question is for Dan Schrag, and it's about the inertias that are built into the climate system that you referred to, and how best to increase the public awareness of the consequences of inaction due to potentially irreversible changes? And one that I have in mind that has not really been mentioned at this meeting is the issue of possible Greenland meltdown from a temperature increase of only 4 to 5 degrees that is not beyond the realm of some of the IPCC projections, and the sea-level rise consequences thereof.

Daniel Schrag: Jim Hanson, as you know, has been very concerned about this recently. I showed a picture of West Antarctica, but it could have been Greenland. The truth is that we have an ice sheet. We have an ice sheet in Greenland, we have a big ice sheet, a couple of big ice sheets in Antarctica, and we're suddenly warming the climate far more rapidly than those ice sheets have ever experienced. Richard Alley is probably most up to date on exactly this is going to change, but as far as I understand it, every time the glaciologists take a new look, they get surprised by what they see. And therefore, I'm actually horrified by the lack of deep understanding of how ice sheets work. It's a very hard problem, I understand that. It seems to me that it's the one part of this, an abrupt rise of a meter or even 6 meters of West Antarctica goes, over a few decades would be catastrophic to anyone. I mean no economist would argue that that sort of sea-level rise over a few decades is absolutely game over. And so it seems to me that we really . . .
that's the really critical part of this doesn't seem to excite people. You know, and maybe this crazy movie that's coming out this spring is going to do something to capture the imagination that people have. Maybe we need some science fiction in here because the science doesn't seem to be capturing people's imagination. Oh, it's called *The Day After Tomorrow*, and it's based on bad science but it's going to be entertaining.

**Geoffrey Heal:** Can I just make one remark on that issue, which is that it's a question of awareness here. I'm involved as a director of a thing called the Union of Concerned Scientists, and one of the things that we do is try to make people more aware of issues relating to climate change. And recently we held a meeting down in Florida where we publicized—which Richard Alley was actually talking about last night at the dinner—which is how much of Florida would go under water, and specifically how much high value property in Florida would actually be under water, under various scenarios about the melting of the ice sheets, the glaciers, and things like that. In what are significantly conservative regions of Florida, politically conservative, socially conservative regions of Florida, we managed to get substantial interest in the whole issue of climate change as a result of pointing out to these people that they were 30, 40, 50, 60, maybe if they're lucky a hundred centimeters above sea level, and that the property that they had saved for for so many years and paid millions of dollars for was likely to go under water at some point within the next fifty to a hundred years in the event of some of these scenarios occurring. That connection with everyday life just hasn't been made enough by the people who are concerned about climate change and its consequences, I'm afraid.

**John Mutter:** Well on those somewhat alarming thoughts, we should break for lunch. I'd like to thank Scott and his panel for doing a fabulous job. I'd like to have you back by one o'clock. We have heard nothing different from the governor. We expect he'll be here at 2:30.