Weather and Imagination
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The Philoctetes Center

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Nersessian:	**Edward Nersessian**
Coen:	**Deborah Coen**
Jasanoff:	**Sheila Jasanoff**
Leiserowitz:	**Anthony Leiserowitz**
LeMenager:	**Stephanie LeMenager**
Orlove:	**Ben Orlove**
A:	**Speaker from audience**

Levy: I'm Francis Levy, co-director of the Philoctetes Center, and welcome to Weather and Imagination. I'm now honored to introduce Deborah Coen. Deborah Coen is an Assistant Professor of history at Barnard College, Columbia University, where she teaches modern central European history and history of science and technology. I was waiting, you know, because weather—where did that fit into modern European history? I mean I guess it plays a rather important role when you look at what happened to the French when they retreated from the invasion of Russia. Her research is driven by an interest in how scientists grapple with uncertainty and unpredictability. Currently, she is studying how central European climate scientists in the first half of the 20th century struggled to demarcate "local" climates in the face of the radical shifts in scale of their patron states. Her previous research probed the intersection of science and family dynamics in fin-de-siècle Vienna. She is the author of *Vienna in the Age of Uncertainty: Science, Liberalism, and Private Life* and a co-editor of *Intimate Universality: Local and Global Themes in the History of Weather and Climate*. Dr. Coen will moderate this afternoon's discussion and introduce the other panelists. Thank you.

Coen: I want to thank Francis and the rest of the Philoctetes Center for organizing this panel, and I want to thank the panelists for fitting it into their busy lives, and everyone here for coming today. I'm really excited that we've been able to assemble a group of scholars whose work is so profound, both academically and at a human level, and which covers such a broad geographic range. So, I'm going to introduce the other panelists.

This is Stephanie LeMenager. She is Associate Professor of English at the University of California, Santa Barbara, and Director of the University's American Cultures and Global Context Center. Her first book was titled *Manifest and Other Destinies*: *Territorial Fictions of the 19th Century United States.* It explored literary depictions of the uninhabitable spaces that resisted Western expansion: deserts, oceans and rivers. It won the 2005 Thomas J. Lyon Award for the best book in Western American Literary Studies. Her book in progress is titled *Weather Events: Climate and Culture in North America*, and she just described it to us as a study of weather and the literary imagination. Stephanie recently held a Mellon Fellowship for research at the Huntington Library. She's also won a number of awards for her teaching.

This is Sheila Jasanoff, who is Pforzheimer Professor of Science and Technology Studies at the John F. Kennedy School of Government at Harvard University. She's also taught at many top institutions in the United States, Britain, and Japan. She holds degrees in mathematics, linguistics and law, and her research has explored from many angles how science and technology become subject to legislation and public debate in democratic societies. She's the author/editor of about 10 books, so I won't name them all, but most recently she's published a comparative study of the politics of biotechnology in Europe and the U.S., which is titled *Designs on Nature.* Sheila has won numerous awards, including being named a Fellow of the American Association for the Advancement of Science.

Next is Ben Orlove, who is Professor of Environmental Science and Policy at UC Davis. He is also an adjunct senior research scientist at Columbia's International Research Institute for Climate and Society. He is an anthropologist by training who has worked in Central and South America, Australia, and now Africa, so he's really covered the globe—even, I think, Scandinavia.

Orlove: Well I did hike for a week in Norway.

Coen: He is now focusing on human responses to climate variability. His research has won major grants from the National Science Foundation and elsewhere. He is a co-editor of the book *Weather, Culture and Climate,* a book that I've learned a lot from. His writing reaches well beyond disciplinary borders, with a book for general readers on Lake Titicaca and a memoir of his father.

Finally, this is Anthony Leiserowitz, who is Director of Strategic Initiatives and a Research Scientist at the School of Forestry and Environmental Studies at Yale University. He is also the Director of the Yale Project on Climate Change. He holds a PhD in Environmental Science, and his research is focused on public perceptions of environmental risk, drawing comparisons at local, regional and national levels from Alaska to Argentina. He has published dozens of articles and won numerous prestigious grants for his research. He's a contributing editor of the journal *Environment.* He's also a very talented photographer of the natural world, and I encourage you to take a look at his website for examples of his photography.

The five of us spend a lot of time thinking about weather, but I imagine not everyone here does, so I'm going to begin just by throwing out a very basic definition of weather, saying a few words about it and then asking the other panelists if they have alternative definitions. The common definition of weather today is the condition of the atmosphere at a particular place in time. We can distinguish weather from climate, where climate is defined as the average weather of a certain place.

I would just want to note three things about these definitions. First, climate is a mathematical abstraction. It's an average. Weather is what we experience immediately, day to day. Moreover, until quite recently, climate was defined as a stable average. In other words, climate change was an oxymoron. It was only in the late 19th century that geological evidence of past ice ages—glaciers in Northern Europe and the U.S.—convinced scientists that the earth's climates could in fact vary drastically.

Secondly, note that the definition of weather is restricted to the atmosphere at a single place in time. We might want to talk about just how big a place, just how long a time that might mean. But for this reason there can't be any such thing as global weather, even continental weather. It's even been suggested that the U.S. has been slower to respond to climate change than small European nations because there's no national experience of weather in the U.S. We're such a climactically diverse country.

Thirdly, this definition of weather, the most widely used today, makes no reference to people. That's a relatively recent departure. Earlier definitions of weather and climate were explicitly anthropocentric. Until the mid-18th century, extreme weather events were regularly interpreted as divine judgments, as portents. The Great London Storm of 1703 was declared by the Queen a token of divine displeasure. As recently as the early 20th century, climate was defined more narrowly as those atmospheric conditions that affect human life. For instance, the great physical geographer Alexander von Humbolt wrote that climate is all the variations in the atmosphere that ostensibly affect our organs.

So today's non-anthropocentric definitions reflect the modern reinterpretation of weather and climate in the 19th century. What had previously been studied as clues to the character of a place and its human inhabitants—a geographic project—now became a sub-field of physical science, which could just as well be carried out in a laboratory experiment, or later, computer models, as through observations in the world, in the field. In other words, the modern science of weather abandoned a human framework. Does anyone want to offer some alternative definitions of weather that you've found useful, relevant to your work?

Orlove: Well, we're in an English speaking context here, so we are used to the word weather, and I now regret not having looked it up in the Oxford English Dictionary that would give the earliest use. But it's cognate with the German word 'wetter,' so it sounds like it's an old Germanic thing that we've had for a while. And the Romance languages—my high school French—is *le temps*. It's *tiempo* in Spanish, which is the same as the word for time, which I think is linked to the changeability. When you use the word people can tell by context whether you mean weather or time. I think there are languages that actually don't have an abstract word for weather. In the one indigenous language I know a bit, people might say, "Is it raining or is it not raining?" That is another use of the word weather in English. You could say, "Come in out of the weather," which would mean, "It's raining outside." If it was a sunny day you'd just say, "Come inside." That thing of whether weather is the events, or whether there's always weather, or is it just kind of when something dramatic happens, is another way that the word plays out. I suppose I'll just think that that's all cultural framing, but I'm sure many different types of psychologists would talk about how attention is given: what you notice, what you don't notice.

LeMenager: One thing that comes to my mind, having done some research on the history of weather observation and the imagining of weather in the United States, is how weather became a problem for nation formation and nation building in the late 18th and early 19th century. Thomas Jefferson was the person who of course wanted to create a national weather service of some kind or another, or a national weather survey. In part, his goal was to try to somehow get the ephemeral quality of weather under control and to create something like the homogeneous empty time that Benedict Anderson says structures a nation, via a kind of disciplining of the weather, or at least a demarcation of the weather as a national event rather than a series of local events. So I

think there have been attempts to assail this definition, or this set of definitions that you offer, and yet I think the definitions have held. In fact, the weather has repeatedly in the United States—at least in the work I've done—threatened various versions of national community and national symbology. That's more of a gloss than an alteration of the definitions you provide.

Orlove: There are different people who can speak with authority about the weather. Jefferson was an early effort in a new nation to say that there's a national way of speaking about the weather. But I think there is also just a common sense way of talking about weather. God knows what psychologists think about that notion of common sense, but it's just kind of the every day, the vernacular. We all experience it. We all go out. We see it. On the one hand, you do want to control, you want to know weather. You really want weather forecasts. I'm certainly aware that there's some snow due to be coming in and I'm kind of thinking about that, glad I packed the right clothes. But I'm also not quite sure it's going to come to pass.

Jasanoff: I think the first point that Ben made about Anglophone countries, and weather being an English word, even if it's Germanically descended, that's really very important. There's the fine British joke that we don't have climate in Britain, we only have weather. That reflects the intense variability of what it's like just to go outdoors. You carry an umbrella and it may be raining one minute and might not be the next minute, and so on and so forth. In India there's not that kind of talk about weather at all. When you get a seasonal change it's fixed in place for a long time. You have the dry season, and everybody knows it's the dry season. There's no point saying, "What's the weather going to be like?" In the month of May, every day is going to be like every other day in Delhi. It's going to be very hot and dry, and you know it's not going to rain. The whole way of thinking and talking about weather there gets tied to something that in current parlance we refer to as 'weather events.' We call them 'extreme weather events.' There's lots of language for the type of storm or the type of wind, but not about weather.

Orlove: It's interesting how everyday conversation about weather that seems in a way so banal is also a rich topic. People in California do comment about the lack of weather. "Just another damn day in paradise."

Jasanoff: But especially alienated easterners who go to California and say, "We miss the changing of the seasons."

Orlove: But even in places that have predictable seasons, people might comment, "It's a little hotter," or, "It's a little cooler." "There's a breeze."

Jasanoff: From my own childhood experiences of the weather in India, what you notice are the short breaks, and when the stormy season comes, the clouds building up and the storm finally breaking. It may amuse you that one of my early weather-related childhood memories is that we didn't have refrigeration when I was very young, and a favorite desert that was made in our house was Jell-O, known as 'jelly pudding.' It got made when there were hailstorms, because people would collect the hail and that would produce the ice. But that's not about weather. You know, it's a whole sort of cultural combination of a break in a regular pattern and something very strange happening, and that then becoming a celebratory occasion and rituals being constructed around it.

Orlove: I'm surprised that I've never stopped to reflect on eating snow, which is something that Americans do—

Jasanoff: With maple syrup.

Orlove: Well, I guess some of them do. I ate snow as a kid, and it would be fresh snow, I assure you. But for the mouths of my kids, I'm always fearful that it's not quite clean enough.

Coen: Tony?

Leiserowitz: We always, as economists, tend to come back to the denotative meaning of things, so we tend to look at dictionaries, and we look for these kind of established, standard definitions. But in some ways I think what's far more interesting and important in a lot of ways is the connotative meaning of these terms. What are the kind of emotions, what are the kind of feelings that are brought up by these terms? What are the kind of images that come to mind, the metaphors that we use to reflect and to in fact construct our surrounding worlds? In particular, weather happens to be one of those things that I like to think of as a social glue. It's one of the things that unite all of us. How many cabs have you been in and the one thing you talk about is the weather? Well, I'll leave that aside for the moment. I think cabbies are one of the best unused resources to communicate about climate change in this country.

But nonetheless, it's one of these things that does unite all of us. It's the one thing that you can actually go to—I mean there's a diversity of people in this city, and yet we all experience something of the same kind of weather conditions. It does make it easy to do that, even in the most urban setting. But I do a lot of work among the Inupiaq Eskimo in northwest Alaska, and there it's central to cultural identity. It's the fact that we are a people who have experienced some of the most extreme and hostile weather conditions on the planet that is fundamental to who we are. In fact, the Inuit are actually suing the United States under the Organization of American States, saying that their rights are being violated and that they have a right to be cold. Okay? "We don't want to be warm. Our whole culture, our whole way of life, our whole mythology, our cosmology—who we are as a people—are fundamentally based on the fact that it's cold here." And as that's changing, obviously many aspects of society, from the practical to the cosmological, are being transformed right underneath them.

So again, I think the dictionary definitions are always nice, but fundamentally it's about how do we use the meanings—the connotative meanings of these terms and these experiences of weather in our everyday lives—that ultimately I find most interesting.

LeMenager: I think it's interesting to kind of move off of that idea of weather talk as speaking to something that we can all relate to as humans and creating a kind of universality, to the other reaction that weather talk often produces, at least in my experience, which is, "Why are you talking to me about the weather?" This is actually a quote from one of my colleagues. The point is, why are you talking to me about something that we know is this sort of fad of communication? We know there's no real content here, that you're using weather as a way of attempting to create a kind of false commonality between us, a common experience, but actually weather itself somehow has no import. We think of it as a fallback. It's a little bit like talking about baseball scores or something with the cabbie. You know, we're not going to talk about

politics because that might be a little too engaging, so weather has this quality of safety and superficiality, and yet on the other hand, as you suggest with the group you're working with in Alaska, it also impinges on us in the most intimate and profound ways and shapes our cultures, our beliefs, our religions, et cetera. So there's a strange kind of opposition between those two modes of conceiving weather as a vehicle for communicating culture.

Coen: I'd be interested in hearing in each of your research—if you reflect on it for a minute—do you think that you treat weather more as an individual or a collective experience? It seems like there are strong arguments for viewing it either way: weather as the romantic experience of nature, the development of a modern self in relation to the natural other, weather, as you've been saying, as a way of binding together a community, a collective experience. So how are you using it in your research? Maybe say a little bit about your methods also.

LeMenager: I'm a scholar of literature, so I actually have a great deal to learn from all of these folks who are doing more interdisciplinary studies of weather than I am, but for me climate has a kind of political valence that relates to ideas of culture, sometimes of ethnicity, sometimes of nationhood. It can be mobilized in certain kinds of political debates in a way that weather cannot. I see climate as the way of speaking for a collective, and speaking on the part of collective action or an attempt to make some sort of intervention. The work that I do is historical, and I'm interested in how certain climates figure in the U.S. literary and cultural imagination as deconstructive of national ideals. For example, when Civil War soldiers, Union soldiers, went down into parts of the deep south, particularly the wet, malarial south, and found themselves stuck up in the mud to their knees and mud caking on their feet—"like suet," one man said, a kind of suet sauce for pudding—they started to sort of—what's the word I'm looking for?—*alienate* themselves from the idea of unionism, which had been a very potent ideology and the reason for going to war to begin with. Once they got down there it was very hard for them to recognize these regional climates as something that they could experience a sort of topophiliac identification for, to use a term from the humanist geographer Yi-Fu Tuan, who talks about topophilia as human love of place. That climate, I think, has never been entirely seen as a national climate, part of America. One of the reasons why people—talking heads on television—kept saying about Katrina, "This is not America," was that they were looking at in fact predictable phenomenon on the Gulf Coast, this tremendous hurricane, this storm, but one that people in much of the country don't like to think of as predictable or natural or part of their idea of the nation and its symbology.

That's just one example. I can think of others, but it seems to me that climate does speak for collective experience, and it's been mobilized in various political ways, sometimes in the service of problematic ideologies, whereas weather does seem to be a more romantic and post-romantic mode of experience that people, in my research anyway, guard as they guard what they see as the value of their own senses to tell them the story of the world really. So, excuse me for a bit long-winded response.

Jasanoff: What I'm really interested in is the ways in which what we know links up with how we choose to do the things that we do collectively. I wouldn't draw a distinction between individual and collective. What interests me is partly how knowledge becomes common property at all, so that we think we know the same things. For instance, why is it the case that there hasn't been just about any controversy about whether climate change is linked to human-made causes when you

go over to Western Europe, but in this country there has been a lot of conversation? Why is there a differentiation of opinion in America and not in Europe? All of the standard kinds of things that you could allege about more different countries, like possible educational differences, technological differences, those don't obtain between Europe and the U.S.

You were asking about methodology. I'm particularly interested in the ways in which phenomena get made visible, measurable, trackable. Weather, as I think, Stephanie, you were already saying, from Jefferson onwards has been a piece of nation building. The same is not necessarily true of the term or the concept 'climate.' In fact, I think that the switch in policy talk from weather to climate to some extent displaces the locus, or adds a new locus of power-making, bumping it up to global. We actually had to create a new institution called the Intergovernmental Panel on Climate Change to produce the data that establishes for the world as a whole now that there is a phenomenon that we want to think of as climate change. Although climate was understood nationally and regionally as well, weather has never been understood globally. That goes back, Debbie, to your initial definition.

How does it happen in the first place that we create a way of looking at nature that is actually not located in the nation state anymore, and who controls the tools and devices? Then, as a science studies scholar, I'm deeply interested in the fact that you get a sort of narrowing of the funnel, so to know climate change as a global phenomenon you've got to control computers and computer modeling. Only about six places in the world have those resources, and everybody else is sort of derivatively dependent. That can open up all kinds of interesting micro questions about how the credibility of knowledge-making is sustained at a global level. It also opens up all kinds of further interesting questions about who actually knows whether it's weather or climate or whatever, because the vast majority of the world hasn't a clue what these climate models are about and what they're doing and why should we believe them at all or not. Everybody in the world has a clue when they go outside, like your cabbies, whether it's raining or not, whether they feel they need to put on a shawl or not. In that sense perceptual weather is a common property; climate is not. So how do those two things operate intention against one another, and for whom, in what ways? That's the sort of thing that interests me.

Orlove: As an anthropologist I'd also see a relationship between the individual and the collective. Much as people speak only with languages that are shared, so too many other forms of activity are based on shared forms, and yet are individual. You used the word knowledge quite a bit and also used the word perception. I think the word perception is an interesting word, and I was struck with Von Humbolt's definition about the organs, the sensible organs. This might be a point to interject the thought that much as we often speak of visible light, light in the visible spectrum, as if in fact our eyes are the product of many millions of years of evolution to this star that we have nearby that keeps us alive, so too our skin is very sensitive to temperature, and the temperature range that we can experience is something that has to do with the area we live in and what we've become accustomed to. But if there are the words knowledge and perception, there's also the word experience, I think, which is an interesting one that links those. The two German words are the *Erlebnis*, the immediate experience, the thing that you have just for the moment, and then the *Erfahrung*, the experience of being experienced, of having lived through something for quite a while.

There's something very immediate, very personal about weather, about weather experience. Those are the two points that Stephanie, you were making, both that it can be very banal and very charged. It's interesting, that ties to another question we might get to, that knowledge, perception and experience in a way are all linked to authority. You can make claims based on all of those, and they're made in different kinds of ways. That's one of the fascinating things about weather. On the one hand, it is so technical and mysterious and the science is remote, and yet that immediate experience is something that everyone has. There might be other areas where science intervenes in public life where people would not feel, I think, that their own personal experience would bear. Weather may be one of the clearest cases where everyone experiences this phenomenon.

Leiserowitz: I actually come at this from a different perspective. In some ways I look at this issue at both levels, but particularly at the individual level to try to understand the collective. By that, what I mean is that I study how whole societies—let's take American society as one that I've focused a lot on—perceive global warming. How do they perceive it, what kinds of policies do they support or oppose, what kinds of behaviors are they willing to change or not. And then from my perspective, why? What are the underlying psychological, cultural, political, even geographic reasons why some people seem to care and other people don't?

One of the techniques I use, to get back to the question about the methods we use, is actually a form of free association. We can all play along with this. I'm sure many of you use this technique in a far more sophisticated way than I do. But I'm a survey researcher, so I conduct nationally representative surveys, which allows me to say with X% confidence that this is what the American people think. So here's the question: what's the first thought or image that comes to mind when you hear the words 'global warming?'

Now, how many people have an image of melting ice, snow, glaciers? Yes, absolutely. There it is. You guys represent the United States. That's by far the single strongest set of associations to this issue. We then ask them is that a good thing or a bad thing, and they say it's a very bad thing. The problem is that how many of us live near melting glaciers or the Arctic or the Antarctic? Raise your hand. Yeah. It's hard to say, okay, it's bad, but how does that affect me? Yes, there are those of us who care deeply about how it affects, say, polar bears. On the other hand, there are plenty of other people who don't really care about what happens to polar bears. That's the other point, is that there are different people within our society. There is no "American public." We're each predisposed to care or not care based on ideology, values, world views, et cetera.

Jasanoff: What complicates that picture is that there's no intrinsic connection between whether you live near the ice caps or the glaciers and whether you care about them, because, of course, America more than any other western industrial nation has this long, long history of caring about the wilderness, precisely because nobody lives near it. It's the sublime, and it's the thing that's out there and it's America's cathedrals, and it's the source of American exceptionalism, and so on and so forth.

In Germany, when global warming first became a national issue, *Spiegel Magazine* had a very famous cover, which showed Cologne Cathedral with just the spires visible and water covering the whole cathedral. To me, that's always been an incredibly evocative image, partly because it's

so different from most things we have until *The Day After Tomorrow*, which was made by a German director, and the Statue of Liberty has all the ice. That's a kind of iconic image that has certain parallels to the Cologne Cathedral. But if you ever traveled in Germany in the post-war years, even 20 years after the war, every time you walked into a church in Germany you would see photographs of that church's history in '42 through '45, the spires bombed out and so on. So this Cologne Cathedral with the spires showing intact but the bottom erased with a flood seemed to me an inversion, and yet a continuation of the same sense of the destruction of civilization that Germans have lived with for decades. So global warming in Germany fell into this preparedness to believe that everything could be lost. Any built structure, any achievement, could be washed away. I think that's closely linked to the fact that there has been no scientific controversy about climate change in Germany to speak of, even though, of course, German scientists sit on these committees and on these boards and so on, so they should be quarreling about the basis of the knowledge. We do. Even if we believe in it, we do. It's quite interesting to think about why they don't.

Leiserowitz: That's a great point that there are different cultural narratives that an issue like climate change can either activate or not. These are whole networks of association—in my terms—in the human mind that predispose one to either accept this as a new idea, or as something that—. It helps explain the things that we're experiencing.

Jasanoff: Do you think these are biological networks of association, or profoundly acculturated networks?

Leiserowitz: Well, both. We are biological beings; we are cultural beings. It's not one or the other, it's both.

Orlove: I've done a few interviews in Peru, high in the Andes, for people who do live near melting glaciers. It's also very kind of very open-ended—"Oh, here are the glaciers, tell me about them." I was interested to see who described the timeframe of change in terms of years, and who described it in terms of generations, or that they did both. I could both listen to the narratives and also make little tick marks and do some analysis. I discovered that there's a third timeframe that some people use there, which is of epics. It was really very troubling to hear people say, "When all the ice is gone, a big wind will come and blow everything away and there'll be no more life." I felt bad interviewing. Anthropologists interview on all kinds of terrible things, AIDS and police abuse and torture, and I thought the weather, at least was safe.

But there's a long history in the Andes of these cataclysmic changes, and from what's recorded of the pre-Columbian religion, from the documents from the 16th century, there were such epics, and the kind of Colonial Christianity really melded together stories of floods and so forth. This belief in catastrophe is something that people can hold in various ways, and old stories can come forward, collective stories, and there's a way in which it is a truth. These people won't sit there and shiver and starve as the streams dry up and their herds die off. They'll move, some of them, and there'll be more infant mortality, I think, if the diet isn't as adequate. But there is a sense in which they're telling a truth. The world will be unrecognizably different.

Leiserowitz: Just a more American version of how these issues get filtered through or resonate with deeper cultural stories—one thing I've found in my own work is that there is a small,

fortunately very small, proportion of Americans who seem to interpret the whole issue of global warming and climate change within the storyline of Revelations. So, "Global warming, I don't care about that. That's actually a good thing. It's a sign that the return of Christ is nigh." That's probably not a story that most Americans immediately go to, but it is a very powerful cultural story among certain groups, and that does shape the way they interpret this issue.

Levy: In Biblical imagery it never seems to rain, of course, in Eden.

Leiserowitz: It never rains in Eden.

Levy: You know, you talk about the flood. We had the flood, and then all the weather changes occur after the Fall.

Leiserowitz: Sure.

Orlove: A nice little fact which just follows: Paradise is, I believe, a Persian word, from 'pardis,' which refers, I think, to a walled garden with spring.

Leiserowitz: That's right.

LeMenager: It's interesting. A couple of things are coming to my mind. One is just that in the literatures that I've surveyed, the most temperate climates, as understood by 19th century geographers, literary writers, and political figures, were first heaven, which was called the summer land, and then California. Just as something to think about.

But I also wanted to ask you, Tony, if Jeremiadic modes of understanding figure into the work you're doing, because you talked about the Revelations as one kind of template through which one might understand global warming. I talk a lot with my students about what sort of narratives would actually mobilize people to act. We talk about the tradition of the Jeremiad and the sense that God essentially chastened those whom he loves. And if we are chastened, if scourges are set upon us—a Biblical flood being one of the kind of meteorological disasters par excellence, in the words of Lucien Boia—then our response should be to make some sort of sacrifice or recommitment to the Covenant, and we will then prevail as the chosen. Yet it seems to me that environmental rhetoric that demands this kind of sacrifice and recommitment to the Covenant, so to speak, has almost no traction with most people. I'm wondering if that's something that you've encountered.

Leiserowitz: You're touching on a very important topic. It's actually interesting, if you look at the history of the environmental movement, how many of the major leaders in environmentalism came out of childhood steeped in Evangelical type religion. In a sense these were often people who, for whatever reason, gave up the faith of their fathers—sometimes it was actually a rebellion against their fathers—and took up a new cause that allowed them to basically go forth and spread the gospel and evangelize in this Jeremiad kind of approach.

LeMenager: Right.

Leiserowitz: So yes, there is this strong fanatic element within a lot of environmentalism of, you know, "Repent, because doom is near." And you're right. It works to a certain degree with certain audiences, but it does not work well at all with many other audiences.

One of the things I'm quite interested in these days is I'm trying to look at the American public and say, who are these different cultural groups and what are the values and worldviews that bring them together? I won't go into that in much depth, but I'm very interested in how different kinds of messages, different kinds of framings, different kinds of metaphors, resonate with different types of groups.

One group, if you give them the message, "Look, global warming is important because it's going to wipe out a third of the species on this planet, including the polar bear," that works for some people. Other people need to hear about it in terms of moral and Christian terms, to say, "This is an important issue." In fact, we're seeing major movement within the Evangelical Right here in this country right now, with a number of leaders coming out and saying, "This is an issue that we need to care about from a moral Christian standpoint. God told us to till and tend the garden. We are stewards of this earth and we are not doing a good job of it. Also, Jesus told us to tend to the needs of the weak and the poor and the sick, and we are people who go over to Africa and help with famine relief and so on. How can we in good conscience ignore a problem that's going to push millions more people into those exact same circumstances?" These are powerful messages for those groups that you would never hear from a scientist. The point is that there are these different themes, and climate change happens to be so fundamental, it touches all of our lives in such deep and profound ways, that it in fact can be framed, described in many, many different ways that are in some ways all equally valid.

Orlove: It does seem that there's not only these different kinds of explanations and framings that you talk about, but they lead to different courses of action. Sometimes they might lead to individual moral responsibility, and there are people who will be very careful to recycle and perhaps not at all work for more collective solutions. Then there are other people who do see some kind of change in policy, and that within different countries, different nations, there are different views of responses to climate change.

Jasanoff: Yeah, one shouldn't lose sight of the fact that these discussions willy-nilly tend to become a bit ethnocentric. Part of that interesting back story that you were telling about the Evangelicals and the part of the Evangelical Right in this country that's pro anti-climate change action—one of the slightly nervous-making phenomena is the coming together of the climate change scientists with these people. Some of my colleagues, who are among the leading climate change scientists in the world, tell very interesting stories about the meetings they've had with these leaders, including, by the way, the Dean of your own school. They went in thinking, "How could we possibly make common cause with these people who believe in Creationism, and that the earth began 6,000 years ago. How can we possibly have common beliefs?" Then they come away astonished and reinvigorated because there's a common sense of stewardship and ethic of caring that they find cuts across between the scientists and the Evangelicals.

But you go into developing countries and you find a lot of talk about how climate change rhetoric is really a whitewash for not talking about other things like inequality, like poverty, like persistent disorder that still continues old Colonial dispensations and so on and so forth. Some of

India's most prominent environmental organizations more or less have decided that climate change in those terms ought to be treated as a rhetorical framing that they don't want to accept because some of the solutions that go with climate change end up perpetuating the same kind of economic disparities that characterize the world today. For instance, what we, in some sense, hail as policy breakthroughs of tremendous significance, like we've decided to marketize emissions. I mean, think of it. It's an ontologically extraordinary move. Who here has seen an emission? And yet we have futures in them. But maybe all futures are things we never could see, but we bet on them. So there's that sort of stuff going on. We give out Nobel Prizes for thinking of how to marketize new things, right? It's considered an act of immense creativity to reconfigure things like weather and climate in terms that allow us to trade it.

So what happens? Well, the people whose climate is cheaper get bought out by the people who've got the money, in a sense. Who gets to plant the trees that are supposed to save us from greenhouse gas buildup? Well, the tree planting is happening in the poorer countries, perpetuating a certain kind of distribution of agriculture versus industry. I haven't done this, I don't know whether you have—the story is too new—but some of the reporting of the unveiling of the Nano in India that I'm sure some of you have seen, the sort of new generation—. "The Model T of India" is the way it's being talked about, that millions will be sold. Of course they're cheap, but of course they're carbon intensive things, so what sort of effect is that going to have? I think that the northern reporting and the southern reporting on this kind of phenomenon illustrates that there is not a universal discourse of climate change with everybody falling into the same bandwagon, even if the climate change scientists are finding it comfortable to talk to the Evangelicals. That is an American phenomenon, a trend that doesn't extend around the world.

Coen: I wonder if we want to follow up on the discussion of how narrative mediates the experience of weather and climate by talking about other media, and visual, as opposed to verbal representations. So—I mean, historically and today—paintings, photographs, movies, the Internet.

Jasanoff: I just have to throw out one tiny anecdote. I went a couple of years ago to an exhibition of Cartier-Bresson right after he died in India, and he did a lot of photography in India. And, of course, Cartier-Bresson's pictures, I mean you just wonder—maybe you don't because you're a talented photographer yourself—but how the eye and the camera lens could have been there in that instant. You know, with the patterns just so. It's a sort of amazing thing. The India pictures are fascinating, but in the same room there was an exhibit of Indian photographers, some of whom had actually been influenced by the Western photographic tradition. The very first one that I saw suddenly made me realize that in all of Cartier-Bresson's work on India that I've seen, weather is not there, because this picture by an Indian photographer was of six figures, very artistically displayed, huddling under a cement bus stop with the rain slamming down, and it was called "Monsoon," or something like that. But Cartier-Bresson's pictures are eternal sunshine. There's no monsoons. It's very interesting, you know, what the western eye sees when it goes to this other place, as opposed to what the indigenous eye might see.

Coen: It goes back to the question of is there weather when the weather is good?

Do you want to talk about *The Day After Tomorrow*?

Leiserowitz: Well, sure. Part of the theoretical background I come from is the recognition within my field about the perception of risk, and how people make judgments and decisions. We recognize that human beings—and we've come to this of late—have two different ways of processing information about the world. One is what we call the analytic system, and that's this slow, rational, deliberate, logical chains type thinking. It's what we go to school to learn, to be trained, to be disciplined how to do. But at the same time we also have this enormous other system, which we call the experiential system, which Ben was referring to before. It's the realm of actual embodied experience, of imagery, of feeling, of emotion, of narrative, of myth, et cetera. This system turns out to actually, if not determine, strongly influence the vast majority of decisions we make in our everyday lives, in fact most of them, of course unconsciously. We're not thinking about most of the decisions we make.

I got very interested in this interplay because climate change is one of those issues that by the time we've all physically experienced it, it's too late. There's so much momentum in these forces that by the time we've experienced it we're already committed to even more dramatic impacts. So I got very interested in the idea of vicarious experience. This is a way that human beings, through culture, through story, one of the oldest human inventions there has to be, find ways to communicate experience from one person to the next, from one generation to the next.

That led me to film, because I would argue that film is perhaps the preeminent artistic medium of our culture that engages directly this experiential processing system. Films give us strong images, vivid images, strong emotional content, characters that you're asked to identify with and to in a sense live in their footsteps as they go through a narrative. The other thing is, of course, that when you go into a movie theater you're asked to check your disbelief at the door. When we go in, we are all willing to suspend disbelief, to suspend critical judgment, and for the sake of the movie, believe in hobbits or space battles in faraway galaxies, et cetera, for the sake of the story. As a result I thought that perhaps movies are one of the ways that scientific information, information about problems like climate change, can in a sense fly in under the radar, engage with this experiential system and change it. I actually did a national study where I looked at the impact of *The Day After Tomorrow*, which was a Hollywood disaster film that tried to represent an abrupt catastrophic climate change. It took a lot of artistic liberties with the science—but nonetheless, we did a survey before the movie came out, another national survey several weeks afterwards, and found that the film did in fact have a very strong impact on the people who went to see it. It made them much more convinced that it was a real problem, that it was much more likely to have all sorts of negative implications. They were more supportive of policy, they were more willing to change their own individual behavior. I mean really a profound kind of a change, and I could go on about that, but I won't at this point.

Levy: Yeah, I wanted to ask, maybe Hallie could be of help. She just finished curating this whole show, and the whole nature of the show is based on imagery of weather and finding an aesthetic premise. Hallie, do you want to come to the microphone and just say a couple of words? I hate to put you on the spot, but you seem like such a valuable Petri dish for this.

Cohen: Actually, a question just came in from one of the artists on the website, Fernando, who's done what he called the Brain Storm series, which I think had to do with inner storms as well as external. But it was very difficult to curate a show on weather, because of the kinds of things that have been talked about here today, and all of the varieties of political, social, artistic, personal,

collective interests that are part of this discussion and conversation. I'd rather offer the question from one of the artists, and we don't have to answer it right now, but as a collective experience do you think weather and climate have played an important role in differentiating most first and third world country profiles? I don't know if you want to answer that now, but you can hold that for later. Thanks.

Coen: So I guess we have two questions on the table now about visual representations of weather, and the question from the artist, which I'm not sure if it relates to the visual issue, but—

LeMenager: I wonder if I could just say a few words in follow up to Tony. It's actually more of a question for everybody than a comment, but I was interested in how non-experimental formally both the films *The Day After Tomorrow* and *An Inconvenient Truth* were. There may be other films about climate change that are more interesting in a formal and technical sense, but I was troubled by the way that a kind of absolute closure is brought to us at the end of *Day After Tomorrow*, and the closure literally is the ice covering most of the northern hemisphere. Then from space we see these astronauts saying, "Look, it's finally clear," because these polluting nations have been covered by ice. Then there's this kind of alternate sentimental narrative about all of the nations that have been mistreated, misrepresented, in fact duped in certain ways by the rhetoric of climate change. The global south, so to speak, embraces refugees from the north tearing across the Rio Grande, tearing down the fences that were built up by our robust security regime. This is the kind of closure that we're offered, which seems like a sort of—I don't know—band-aid for the troubled liberal imagination, perhaps of Emmerich, the German director, but also for the American viewer who might already buy in to the possibility of climate change and his or her own implication in that problem. Then with *An Inconvenient Truth* we have a film that's not really a film, it's a lecture, which in a way I love because I love the thought of a kind of nerdy lecturer like Al Gore becoming this wonderful, masterful film: a film that everybody just thought was the film of the year and so exciting. But it's not a film that really utilizes film technique or film artistry in any way.

So for me, those films were narratives that offered solutions, that offered provocations to the imagination, that offered the fantasy of an end that has not yet come, which I think is important for us to see. But at the same time they didn't call upon the senses in the way that books that try to represent the global do, where I think the global and global environmentality are called up more along the temporal axis, where people are trying to think about simultaneity and lives lived in different parts of the world by strangers, but nonetheless lives lived simultaneously. There's something about the way in which film has so far tackled this problem that seems very—it seems to not challenge the senses very much, or really challenge the imagination very much. This may just be my complaint, but I wondered if others saw that as a potential problem.

A: If you watch the recent playoffs between Colorado and Arizona, they were playing in snow. It changed the whole nature of the game, it changed the whole nature of what the players could do. That to me is like an example of what you're talking about. To me it seems like the difference between weather and climate is not really that much. I mean it's a historical abstract. It's really about weather. Every year, for example, in baseball, the weather changes around World Series time, and it's just not the same thing. The same thing with football when the Patriots play in tremendous snow and everything—they're not the same team that they are otherwise. You've got to look at the individual and the collective, as you said, the collective change of either players

and also those watching it. And if you take history—for example, I took the History of Russia at one time. You look at 1812, supposedly, and it's probably somewhat true that because of the weather the Russians won, although the morale of the Russians was better than the French. I mean the French were going down, and the Russians were coming up. They were fighting for their fatherland, motherland, whatever you call it. Or if you take World War II, it wasn't just the weather that beat the Nazis, not at all. It was the morale and the way the Soviet Red Army fought that won. So there's both aspects to this thing. There is the way the humans are motivated, and there is the conditions. But weather every year is somewhat the same, you know? It might change, but you could predict it to a certain degree.

Leiserowitz: If I can kind of springboard off of that, I think the definition was given earlier that climate is a mathematical abstraction of weather. I agree with that from a scientific standpoint. But on the other hand, I think we are all intuitive climatologists. We all, because of memory and experience—remember what the weather was like when we grew up, and we have some way of mushing all those years ago and saying, "Gosh, I remember when I was a kid it used to snow a lot, but it doesn't seem to snow so much anymore." In fact, my own research is finding this over and over, that many people are in fact drawing on personal experience to track change over time.

As an example, I was talking to a guy up in Alaska, and he says, "Oh, I know exactly what you mean." He said, "Twenty years ago, whenever I would take my kid trick or treating around Halloween, we would have to choose costumes that were like the Michelin Blimp. The kids would be totally covered to keep warm as you went from door to door." He says, "Now you can go out trick or treating in your shirtsleeves."

That's the kind of thing that people do—draw upon their own personal experience—and I think we do have a sense of whether the climate has changed. Now that doesn't mean that our experience is always right. Our experience is obviously limited to what we personally have experienced or what our immediate friends and family have experienced and told us about. That's one of the real powers of global science, is that for the first time we are able to piece together global weather and track it in averages over time. We wouldn't know about global climate change if it wasn't for that scientific ability. But nonetheless, I think the individual experience still plays a role.

Orlove: That Halloween example is just a fantastic one, because I as an anthropologist might imagine that it's only in traditional societies, some peasant village where there's the annual festival and you do something and there's some event, that people would track the climate. But here we've got Halloween, we've got the World Series, and there are many, there are enough points. Now, there is the myth of the white Christmas, which is a song more than ever really being reality for much of Americans. So there's the models of how the weather should be, which I think sometimes are a little bit askew with what the past was, much as memory can be false. But these are in a way both vivid individual experiences: this man who will always remember taking his kids with one kind of costume. It's this individual experience, but it's also marked by a collective event. He could have perhaps remembered, my kid's birthday party on October 20th, but it's more like that Halloween is just so memorable, and it makes a good story. It's easy to convey, to tell. You can narrate it.

Coen: I think now that we're talking about early childhood memories we should open up the discussion to the audience.

A: What you said was interesting, this issue of perception versus reality. I mean global warming is more or less a proven scientific reality as far as I understand it. But if you look at the reason that the average American believes that, it isn't because of believing the science so much as because they think they have noticed the weather changing, and therefore they have concluded that global warming is happening, even though it is also scientifically demonstrable that the variations that we see day to day could very well be caused by things that have nothing to do with global warming and might be normal variations within a smaller set of systems. That I think is interesting to think of.

But there was a related point that I was thinking about as I was listening to you. It depends on how broadly you define what climate is. So much of the discussion has been based on our perceptions when we describe what we perceive to be climate and weather. But in reality there are a lot of things that are scientifically measurable that are not measurable by our immediate senses, which are changing dramatically. There's an interesting one that I happen to have written about, which stuns me how little attention is given to it, and that is the increasing prevalence of electromagnetic fields in the atmosphere.

If you think about what it is that makes everyone in this room's cell phone work all the time, it is a reality that there is a massive change in what used to be an essentially natural electromagnetic environment that has been permeated by transmitters of vast range of frequencies and at vast intensities that are increasing every day. There's a term that has been used, 'electromagnetic smog,' by the relatively small number of people who actually even think about this. But the reason I mention it is that it's a stunningly small number of people who ever even give this any thought. The only way it ever comes up is people worry if their cell phone might be giving them cancer, or they worry if the power station might. But the reasons that those could potentially give us cancer, and it's not dismissed as a possibility, is because they emanate radiation that does extend throughout our environment at various levels of intensity and frequency. If you could see the radiation in this room and you'd been here 10 years ago, it would have been gray, and today it would be black. It's just worth noting, I think.

Orlove: Just this whole question of how you can feel weather and experience weather—it's actually quite terrifying to think about all these changes to the electromagnetic field, so I'll probably worry about it for another 15 minutes and then return to whatever was in my mind. But we can believe it, and I might notice if my cell phone is a little quirky. I might remember that. Somehow I think we seek confirmation for beliefs or something. But the weather—just to go back to it—it's that intimate quality, that weird mixture of banal and extraordinary. We all can experience weather. We think that as climate change comes, we're going to be here to see it. And there are other kinds of changes, these genetically modified foods. Your corn flakes: do they have genetically modified corn or not? You can't tell by looking at them. There's so many of the environmental threats that are invisible and imperceptible, and weather is different in that way. That's just one of the things that's so distinctive about it.

Jasanoff: I'd like to make a comment that ties this back to what Stephanie was saying about the films before. I think the whole question of how we see things collectively or individually is an

extraordinarily important political question. A colleague of mine at the Kennedy School said after Katrina that it took a terrible hurricane for us to see poverty in America again. I started wondering who is the "us," and to whom was poverty invisible that it took Katrina to see it? Anybody who ever went to New Orleans before Katrina knew that if you were white, there were places you could go absolutely safely and other places where you shouldn't go, and anybody knew what the map of the city was like, and that there were poor places and rich places. So why did it take Katrina to make it visible?

From that point of view, your sort of traditional resources of filmmaking—I mean if you see these as essentially propaganda films, even if we're for them, propaganda films don't usually use very subtle techniques. They take the sort of established rhetoric of visual communication and play with them and build on and with them. We're talking about a polarized arena, where people are trying to convey particular messages. I do think that the visual stuff is extraordinarily important and we should be thinking about it, and I don't think we've begun to scratch the surface, but one question that I think we have to keep in our minds is who has the capacity, the resources, the technical know-how, the ability to reach out to television and other media to get their techniques of visualization made to be the common discourse at all? Al Gore can do it for a whole set of reasons that actually include the White House and American political power behind it. Not every one of us that wanted to make a message that highly visible could go out there and make it visible.

Orlove: If I could just follow up on that, and then—the question, the person who's surprised by the poverty, or, "We haven't known about the poverty," in a way may lead a life of comfort and oblivion—

Jasanoff: A Harvard Professor typically does.

Orlove: But the truth behind what the person was saying is that Katrina created a scandal. A scandal may be something that people haven't known before, but it's a truth that's shared publicly, and—again, linked to what Tony was saying—it's also something that's felt. It's not really wrong, but it has a visceral kind of quality. You could either go in a representational, public culture sort of spin on scandal, and you could also do a more limited tension. The world is too filled with scandals to keep track of. But there was that conjunction of the weather and the visibility that did make that scandal.

Coen: I'm just noticing an interesting theme emerging here, which is that our experience of weather has a lot to do with the communications technologies that we have available. It's well known in the history of meteorology that the ability to track storms, for instance, depended on the development of the telegraph. Telephone lines were even used as measurement instruments in geophysics in the late 19th century. Do you want to say more about how changing technologies—

Jasanoff: I'm sure we can come back to almost anything we want to.

A: Basically what I wanted to get into was something that's concerned me for many years, and in respect to the global climate issue it's being addressed by most people from an ivory tower perspective. By that, I mean most of us are unwilling to look beyond our immediate areas of

expertise. We've all addressed that to a certain degree. I believe Sheila and yourself, Anthony, perhaps have a somewhat broader perspective. For example, we talked about collective, as a group, and my own feeling is collectively most of us are looking for an easy out rather than having to commit ourselves to doing something. Stephanie talked about Yi-Fu Tuan. He has the answer to some degree, because in his early books at least, he dealt quite frequently with orientation of cities, urban environments.

Speaking of urban environments, the crux of the issue comes down to regional impacts to some degree. Now, urban heat islands are pretty well established and accepted. That's clearly manmade. We have lake effect snow and rain, something else that's basically well accepted. El Niño is in the news every year. That may be natural, but that's accepted. Yet when it comes to alternative energy approaches—I blame the media mostly, because they should be doing their job. I like to believe that the scientific community is doing the work, but it's just not getting out there, although I can't find that much addressing it.

But there isn't an environmental energy source that doesn't have a problem of one sort or another. Personally, I think boiling water with nuclear power is a bit of overkill. The alternative sources have their own problems, but they can be dealt with readily now because they're not widely spread. Solar energy, for instance, photovoltaic cells—to get significant amounts you have to cover a huge amount of land. There's no way that is not going to affect microclimates in the immediate area. Same thing with wind farms—anything that's downhill. Say you set up a wind farm at the head of a valley. You will affect the microclimates downhill. The amount that we need that will do that we certainly don't know, and of course you can start playing with chaos theory as well and how that boils into it. I don't believe the existing climate and weather models right now have the ability to even handle that to some degree, because a lot of that could be put to some good use, as far as I know. Fine, we'll cover the rooftops in urban areas with collectors and get rid of the heat that way. But creating electricity necessitates energy conversion, and once you deal with energy conversion there are pluses and there are minuses, and that is not being addressed. That's the problem with even things like Al Gore's movie, which I think was great for most people, but he did not address the fact that nothing is all green. Now's the time to address them. And perhaps you can address it, because you're involved in the technical part, but even artists—at some level they're the ones who should say, well, wait a minute, is everything perfect?

Jasanoff: The other area I work on, other than environment, is biotechnology and genetics. It's interesting that the art world seems to have done much more with producing critical commentary, from the glow in the dark bunny to various other things. It's not hard to find artistic works that either make fun of, or display horror at, or mobilize politically opposition against the products of biotechnology. It's very difficult to find a comparable body of work in popular visual culture that deals with climate related phenomena.

Orlove: Biotechnology in a way is even more intimate, in that it's the cells in our body. We eat the foods that are—or perhaps our DNA will be rearranged. I think that's immensely troubling. But there is also a way that its invisibility requires it to be rendered visible.

Jasanoff: I think that's right, but it's also a place where nature and culture come together, and people's sense of being offended at blurring those boundaries. So, of course we have the Franken

morpheme that we get attached to anything to convey that sense of the monstrous. There isn't as yet a similar discourse of monstrosity around changing the climate and making things untenable because of the kinds of things that we're bringing about climatically. Maybe it's because of temporality, to some extent. There's a gradualism to it.

Orlove: There is, and there may be sharp changes. There may be these events that go in with this vividness that are also collective, and you can pick whatever they will be. Will Venice have to be abandoned, for instance? There's just no question. So when they have to actually move—it's troubling to even think of moving the Piazza San Marco somewhere—to Disneyland.

Coen: It does seem like it's harder to draw a line between the normal and pathological when it comes to climate than when it comes to biology.

Jasanoff: Well, except for the scientific community it seems perfectly unclear where the line between normal and pathological is. For instance, we have scientists at most major universities these days happily creating things called chimeras, implanting human neuronal cells into mouse brains and so on. From a lot of points of view you might think that that was crossing the most ordained, divine line in most world religions and so on and so forth, and yet there's no felt offense at some of those. There are sort of bioethics bodies that I sit on, and so on and so forth, and the discussion there is really quite bland. People say, "Oh well, it sort of depends. Are we talking *Stuart Little* or are we talking about *Rats of Nimh*?" Or they say, "Well I wonder what it would be like to train my lab technicians, or my animal technicians, if they come in the morning and see the mouse reading the newspaper." But they're not offended at the thought.

Orlove: Anything that'll get newspaper circulations up, I'll tell you, that's another thing you can worry about.

Coen: I'm going to let Tony respond and then we'll take these questions.

Leiserowitz: One thing I'm really struck by is that you just talked about one of the crucial cultural narratives that we use to interpret biotechnology, and that's *Frankenstein*. Or Goethe's *Faust*. They are these deep cultural stories in which we are told to be skeptical of the scientist, the mad scientist who comes up with the technology that ends up either destroying themselves or—

Jasanoff: That affects life.

Leiserowitz: —or affects life in some way. So there's an already set storyline. Likewise, in climate change skeptics, I'm amazed at how often the naysayers use things like the story of Chicken Little. But I bet if we took fables, children's stories, and used them as a template to see, okay, where do we see these being used out there, we'd find them everywhere. So story is crucial to this. I've had a number of conversations with good friends of mine who are filmmakers, and one in particular just argues, he says, "Climate change is a major problem because our existing narrative structures in the west simply can't handle it." They don't work for this particular problem. One particular reason is because you don't have a good guy and a bad guy. The bad guy is all of us, and I don't want to be a bad guy. I want to say it's still the scientists, or it's

Monsanto. They're evil and they're potentially destroying the planet. I don't like a story where, hey, it's me that's causing this.

Jasanoff: But Debbie's the historian here, and I think that looked at historically we'll get other sorts of stories about biotechnology as well. Just a personal story, because I've been doing research in this area enough to have become living history myself. Back in the early '80s, when I was doing some comparative stuff on biotechnology—before it became a big issue, which it became more starting in the 1990s—I walked into a Greenpeace office in the UK. Greenpeace UK is one of the most active environmental groups there, and I asked them why they weren't—why this wasn't on their agenda, biotechnology. They said, well, you know, our mode of operation is campaigns, so-called campaigns, and there's nothing to mobilize around. We can't organize a campaign around biotechnology. Well, ten years later Greenpeace was dumping soybeans at the end of Downing Street with a truck emblazoned, "Tony, don't swallow Bill's seed." So they had obviously figured out how to campaign.

LeMenager: I had one just quick follow-up about the problem of narrating climate change. I've read a couple of what I would consider not very successful climate change novels. One is a novel called *Carbon Dreams*, Susan Gaines, and I think part of the problem is that it seems to take place at these vastly divergent scales. You have on the one hand this moment in that novel where the narrative voice is actually, it seems to be the voice of some sort of a planktonic creature, which is suffering famine because of the warming of the global seas, and then on the other hand you have this intention to invoke a kind of global scientific community at a massive scale. I think one of the things that literature does very well is in fact create and structure scales, but when you're talking about a micro scale, vis-à-vis macro, and there's not a lot of in between space, which is where I think we usually confect to narrative, that is a problem. I think it is one that will be worked through, but it hasn't quite happened yet as I see it.

Orlove: There's a science fiction writer who lives in Davis, actually, Kim Stanley Robinson—

LeMenager: Yes.

Orlove: He's a fairly successful—

LeMenager: *Forty Signs of Rain*—

Orlove: His *Mars* trilogy I think was successful in terms of how we might destroy a pristine planet.

LeMenager: His work reminds me a little bit of Jim Fleming's work on *The Weather Changers*. He talks about terraforming within literature, in other words, forming earth within literature, and how as a science fiction writer he can preview the contingencies that his plots will set in motion, so the same kinds of risk scenarios that we deal with in real life aren't necessarily a problem, of course, for an author. I think that that's in a way one of the reasons why narrative, again, doesn't quite work to capture what we're talking about here. There's so many different feedback loops, and so many kinds of contingent problems that could come out of this. How do you show that visually in a film? How do you represent it in literature? There's a solution focus quality, I think,

to Robinson. I think they're really interesting works, but I don't think you'd get a sense of all the divergent paths that this sort of problem could take, and the multiple feedback loops.

Levy: Do you think the aesthetic mode is more synthetic than the scientific world in the sense that you look at things in different paradigms?

LeMenager: I do, although we can think about postmodern fictions that are not synthetic, and we can think about various kinds of poetry that resists sequentiality. The problem is that those kinds of literatures are not read by many people, or read by only a typically elite group of people. So then the political potency of the media falls into doubt.

Jasanoff: It's interesting that we haven't talked about Michael Crichton, but we have talked about *The Day After Tomorrow*.

LeMenager: Yes. I heard him on NPR talking about how climate change was actually a cover story for the problem of poverty, which completely blew me away because my perception of Crichton—and I have not read *State of Fear*—was that there was nothing interesting about what he had to say. But he actually made an argument about how this was a way of not looking at poverty, this whole question of, you know, if I buy a Prius then I'm a good citizen, I don't have to worry about New Orleans or these other kinds of scenarios.

Jasanoff: It's a very angry piece of trashy literature.

LeMenager: Yeah. That's what I figured. That's why I've been avoiding it.

Coen: We have people here who've been standing for a while.

A: I work with an organization called Eco Arts, and we bring together major science, environmental, arts, indigenous, horticultural and educational organizations to look at issues of climate change and sustainability through various kinds of activities, performances, exhibits, talks, tours, all kinds of stuff. In fact, we have here an exhibit called "Weather Report: Art and Climate Change" that was created in Boulder by Lucy Lippard, who is a well-known visual arts curator. She selected 51 artists from around the country and the world, and I'd love to talk to you about that.

Eco Arts works with science organizations like NOAA and NCAR and Instar and CIRES and all these acronyms—I have no idea what they mean—and various national as well as local artists and performers. It's built based on a study that I read in the *Journal of Environment and Behavior* that kind of goes at your discussion of the whole idea of the mind and the body working together. The study asks the question, why is it that so many people know so much about environmental crises of various kinds and are just not really doing much of anything about it? One of the study's observations was that most effective action is a combination of cognition and affect—your mind and your heart working together—and that most study of environmental problems is cognitive, the sense that we have a problem, let's come up with a solution. There are hundreds of solutions. They mostly sit on shelves, they believe, because there wasn't enough affect to put them into action. So they believed, at least in academia, education should be more affective.

I notice outside of academia that if—and I will say 'if' with due respect to my dear environmental colleagues—an environmental group goes charging ahead with great passion, great effect, but not good science, its argument is also often over, because anybody who's against what they're trying to do will poke holes in it. The idea of Eco Arts is bringing together the cognitive power of impeccable science with the effective power of great art, and then in that half an hour that the marketing people tell us we have between the moment that somebody's deeply affected and they go back to their normal deadened lives—I'm speaking of myself as well—that you offer them practical nonpartisan action steps to do things. We've had tremendous success with a lot of this. One of the things that we're trying to do desperately is to work on the nonpartisan part, because, with all due respect to Al Gore, so many people dismissed climate change as a political—you know, whatever—and *Too Hot Not To Handle* is a very good climate change film if you haven't seen it, that's actually told by scientists, that's a much better alternative.

I'm really interested in the power of the arts and what everybody has been talking about, that notion of narrative and how do we ignite the population with narrative. The films that were talked about, neither one of them really work in terms of doing that. I've been collecting sort of arts power moments in the history of the world, when a particular artwork or a movement has been able to shift behaviors and beliefs, or beliefs and behaviors. I'm thinking about *Uncle Tom's Cabin*, for example. That really just ignited the country in terms of discussion of slavery and Abolition. I don't believe, with all due respect, that climate change can't be discussed in a narrative way. I think we've had success in doing that in very tiny ways that we're hoping to develop further. But I think that it's actually this moment right now, this time of trying to shift people from thinking that it's not a black and white issue, it's not a thing about blaming, it is about taking responsibility. I remember reading an article that Tony Kushner wrote that the difference between great art and sort of agitprop is that thing where you really are looking at this agony that we're all in at this very moment, trying to make this shift.

So this is all this blah, blah—but what I really want to know from each one of you, coming from your extraordinary vantage points, and the research that you've done and the experience that you've had and the scholarship, what would the narratives that you would want to see being created through the arts at this time? What are those things, for example, that you see that America thinks about climate change? It has to be personal, it has to be visceral—but what else? So give me a movie. Or a dance, or a theater piece, or whatever.

Jasanoff: Are you going to give us time to think about it?

Orlove: There is one person who's trying to get climate change into the media, who I happened to be at a conference and meet: Andy Revkin. He's a science and environment reporter for *The New York Times* and has a blog. He says that it's actually very hard to write about climate change because it mostly seems like it's far away and in the future and not so immediate, and it's that whole point of gradualism. I think that's perhaps, if not a solution, at least a statement of the problem, and it might lead towards finding some kind of solution, or finding ways to make it more immediate, trying to find the pieces.

The maple syrup in Vermont is I guess one of the things. I don't know if you have other examples. NPR did one of their April Fool's stories on exploiting Maple trees in Vermont. The loss of the fall color in New England is getting a little closer.

Jasanoff: What you need is a new Charles Kuralt who is going to go and tell these vanishing stories. The kind of book is Rachel Carson, right? That was a problem that created a particular brand of environmental movement, which arguably has run its course. But nevertheless, there's a book by a scientist who, of course, is vilified even on the pages of *The New York Times* by some others of its science writers even to this day, but nevertheless what she did was take an invisible problem, a collective problem, a widely disbursed problem, and made it into seeable stories. The kinds of stories that resonate in America are loss stories. Eden was and now is not—that kind of story is very powerful, and Rachel Carson told that in *Silent Spring* in a brilliant sort of way. I think Charles Kuralt's *On the Road* series, which among other things got the bottle bills going all over New England, for instance, was also that kind of narrative of the loss of Eden. It used to be that there were these beautiful roads and these beautiful places and now look, we've littered them, and what a scandal and a shame, and we can clean it up. So I think those are stories.

But I just want to say one thing which strikes me as cutting in a somewhat different direction. I think we've produced climate change as a problem, in part by erasing the very immediacy of it. In my own work I've shown over and over again how significantly the Apollo missions and America's space adventures affected our ways of thinking about the climate, and there's a very direct visual, rhetorical and political connection between the capacity to see the earth in a systemic way from space as the enclosed biosphere, and hence limited and hence fragile and so on and so forth, and the rise of climate consciousness. I think that that line of connection from visual to aesthetic to political to moral has resonated in America in part because we have a long history of looking at nature in that sort of transcendental way. If you think of the Hudson Valley painters, the paintings are of the sublime, and people, if they're represented at all, are teeny, teeny figures, very iconic, usually in the center of the picture and usually reduced to nothingness. If you think about histories of American Colonial expansion, it's been at the expense of erasing the fact that there was human habitation there before, so that the first arrival of the Europeans was indeed the moment of encounter with nature and the previous things didn't exist.

A very poignant moment to me is when the World Commission on Environment and Development, which produces the idea of sustainability as a global way of thinking about these issues, goes around the world having hearings before it publishes its report. There's a little quotation in *Our Common Future* where they quote a Brazilian person responding to them at one of these regional hearings. The Brazilian guy says, "You talk a lot about survival, but remember that some of us still live. And we who still live do not want to be brought down to the level of survival." Now, it's a very sort of rich and paradoxical statement, but if you start thinking about what it's about, it's saying you guys, with your superior size, your superior knowledge, have indeed created a problem that is so systemic that it's not really linking in with us who still do this thing called living. So survival is too global, it's too abstract, it's too collective, it's too model-bound, and we need the return to the situated, clinical, local, individual, personal gaze in some way.

I think there is this sort of translation problem—you referred to it before—. I don't think it's a problem of finding a middle language. I think it's a problem of connecting this ongoing set of

things. Tony also referred to it when he said there are two ways of knowing. I don't actually think there are two ways of knowing. I think each one structures the other. But in any case, the survival talk and the life talk are not often in conversation. I think for you the challenge is to figure out how to do that. I think Rachel Carson is a good example of a book.

A: I have an observation and a question. The observation is that it's interesting, and maybe it has to do with meeting in Manhattan, but the one historical experience that we all share about the climate/weather is agricultural: droughts in the Bible and pre-Biblical times, periods of terrible droughts, the flood. As a human group, we've really dealt with these issues for a very long time. When I came and joined this mob there were only two billion of us. Now there are I think six, and we're headed for eight, and that of course makes a huge difference in this.

So that brings about my question, and my question is premised partly from hanging around this building for the last 40 years off and on. Should I feel guilty about global warming or can I see it more as a disease? In a way I think about it a little bit like HIV, because I felt guilty about HIV. About 1978 to 1982 I felt guilty about HIV, and I'll explain to you why. I felt guilty about it because I was seeing people who had a disease which looked like it was a viral infection, and I couldn't figure out what it was about. In '82 a couple of smart people figured out what it was about, and then I stopped feeling guilty about the situation and I began to look at what could be done about it. So far, not a hell of a lot has been done about it, and about 30 million of my fellow creatures are infected with this terrible virus right now.

Don't be afraid when you answer my question about feeling guilty that I'm going to turn the lights off on you. I won't. I will keep my hands in my pockets.

Orlove: I think guilt is so connected to responsibility, and responsibility in this case is so collective. I think AIDS is noticing a problem, considering a possible cause of the problem, and not spreading word about the cause. That's certainly not a strong parallel with climate change. Even as it's a difficult moment and we're kind of struggling for ways to take action and ways to represent and ways to draw on the imagination—to turn to a key element of the name of the center—we're also in an open moment. The responsibility often sounds like it's something that can be discharged: you see responsibility and then you have the action that meets that responsibility. I think it's going to take many small acts and many collective acts.

A: I wonder whether this really is a responsibility, or whether it's just a phenomenon which is partly a function of the fact that there are six billion creatures who use fossil fuels, who have invented fire, and who are polluting the environment in this way. We'd better think about how to adapt to it and deal with it—

Orlove: Linguistic anthropologists have determined that New Yorkers don't interrupt, they overlap, because they know their sentences are going to end. So I'm going to overlap, and just say that there are people who live in countries with equal standards of living as in the United States, and half or less of the energy use. There's a lot of room to be made with conservation. We're committed to a bad light use and transportation system, but we can change it.

Coen: I think it's an interesting question of whether guilt is a spur to action. Is it a productive emotion in this context? I don't know, Tony, if you've done any research on this, but

Leiserowitz: It's an issue that's being discussed a lot, and so the little bits of evidence that we have is that we're all looking at the fact that emotion is one of the primary motivators. Information and knowledge alone doesn't do anything, but you've got to engage people's emotions in one way or another. Guilt is one of the emotions people look at, and in fact there's a fair amount of evidence, and don't tell my mother this, but that guilt actually works to some degree. Because it does invoke this sense that I need to do something, and it is a motivator.

Another major emotion that people are often pointing to, however, is what's the effect of fear? Because, as we were talking about before, much of the discourse around this issue, and around many environmental issues, is doom and gloom. It's catastrophism—we're going to bad places, and so be afraid. Does that work? Fear is a dangerous one. It's a very dangerous emotion, yet it's also potentially a very productive one, and I would say that what the research shows is that fear can be very productive, if as soon as you evoke the sense of fear you give people an actual action they can go do. What people do not like is to be scared and then, I don't know what to do. Then the reaction is I'm going to deny it, I'm going to displace it, I'm going to sublimate it, I'm going to do something else with it other than act. So fear can be useful, but it's a very here and now, let me do something kind of emotion. Look at the history of political speech and you can see that fear can work in a given situation.

LeMenager: I wonder if I could just briefly tie this back to the last questioner's question, because it seems to me like part of the problem is of both fear and guilt being a bit amorphous in the case of climate change, whereas in the case of HIV we kind of know that we should feel guilty, or particularly in that historical moment guilt was a kind of knowledge once it was discovered what the disease was. But here there's more of an amorphous quality to what is actually being experienced, and I think one of the reasons that books like *Uncle Tom's Cabin* were so successful is because they enact the drama of witnessing, and that drama of witnessing involves witnessing specific kinds of torture, and, in fact, identifying empathically with the victims of that torture. To me one of the most successful narrative objects that's been created has been Spike Lee's series *When the Levees Broke*, about Katrina. In some ways one could say it's not even about climate change, but it is about climate change in the sense that it's about the specific effects of that event, that signal hurricane, on a group of individuals. We're forced to listen to their testimonies, and so it's a specificity that not only is a spur to action, but also narrows our affect in such a way that we know why we feel guilty. So I guess that drama of witnessing is something that I think should be part of any kind of narrative form that addresses the problem.

Leiserowitz: That goes back to your question about other stories that we ought to be telling. Another fundamental human emotion is empathy, and that I think is absolutely central to this story. My own work shows that most people think of global warming as this distant, abstract, complex thing. They think it's going to happen to other people in places far away, not Americans—small islands in the South Pacific or something like that—and in the distant future. 50 years, 100 years, if ever. Not now.

Yet there are people whose story can be told right now. This is why I went to Alaska. The Arctic has warmed twice as much as the rest of the world. Parts of Alaska have actually warmed four times as much as the rest of the world. They're seeing severe significant impacts right here, right now, and these are Americans. So what's their story? What are they experiencing? How is it changing the way that they live? And that's just one corner of the world. We could go in lots of

other places in the world where climate change is in fact already taking hold, and it's those stories that I think are incredibly powerful. To see people's very sense of themselves and how they react emotionally I think can have tremendous impact on putting the flesh on the bones of this story.

A: I have first a question for you, Tony, and that is what are the other first associations that non-U.S. citizens have? Then I just want to throw out a comment. Clearly your observation and other people's observations that it's important to look at the variety of ways that people can be touched and what needs to go into really motivating people to make changes without overwhelming them with fear and so forth and so on reminds me of research that I think took place at UCSF Medical Center when I was there, the '60s and '70s, when they were looking at what kind of information to give patients pre-surgically. It turns out there are maybe two or three different ways of answering that question, and of course it depends on the individual. Some people are affected by fear. Some people are affected by no information. But the better the recovery rates, the fewer requests for medication post-surgically. Other people want to have strategies. So it's the same kind of thing.

In terms of a potential narrative, what occurred to me as I was listening early on is in the realm of food, which means something to all of us. There are these rituals that are centered around the weather in terms of what we eat when, which you touched on. But then I thought about the fact that there's this current trend, I think internationally, towards local seasonal, the climate-related eating. That seems to me something that touches on not the negative but the positive. That might be an interesting route for even people in Denver, or in Boulder.

Leiserowitz: Was your question about other associations within the United States?

A: No, outside.

Leiserowitz: Okay, in other countries. Well we don't know in large part, but I have done a study, for instance, in England, and instead of melting ice the primary set of associations there is to flooding and sea level rise, and rain. Anything wet. Which goes back to the point Sheila was making earlier. I can't say much more than that, just because the studies haven't been done yet.

A: And in the U.S.?

Leiserowitz: In the U.S. the second most common set of associations are to generalized warming trends. So when you think of global warming, temperatures going up—not particularly good or bad. Then come associations to the impacts on non-human nature, so other species, other ecosystems and their potential threats. Then associations to the ozone hole, and this is a long-standing finding in the United States and around the world that many people think these are in fact the same problem, and they're not. They're very different problems. I'll go into this for a moment, because it touches on the role of metaphor. People first learned about the ozone hole, which is a wonderful term. The ozone hole. It is a metaphor. We all have the embodied experience that when there's a hole in a protective layer, like in your roof, you know what you're supposed to go do. You've got to go fix it, right? The term itself carried with it the thing to do. Then coupled, of course, with these wonderful images of the hole itself as seen from space. I think that one-two punch really had an enormous influence.

Then people learned about this thing called the greenhouse effect. People stick these two metaphors together, and many think that thus the protective layer is the greenhouse, and how global warming is caused is that there's a hole in the greenhouse that's either letting more sunlight in and warming up the planet, or alternatively, the heat's going to escape out the hole and we're going to go into an ice age. Now, you can see the logic in that. It's perfectly rational. It's just wrong, because the underlying metaphors are wrong. That's always been a problem for climate change. Climate change—what is that? I mean what image is there? That's nothing. It's purely abstract. Global warming is not much better because the fundamental metaphor was a warming. Who doesn't like to be warm? So the power of metaphor can be really important in the way these things are termed in the first place.

Jasanoff: But we shouldn't make the mistake of running too hard after metaphor, because ultimately we fixed the ozone hole not because it was like a roof—well, maybe it was like a roof and we could send the carpenter—but because we knew who the roofer was. There were a very small number of companies making a very small number of chemicals, which had been in circulation for less than 30 years. They were quite widespread, because people thought they were safe, but the very same companies that had introduced those chemicals into the world in the first place had started doing research to find substitutes. Dupont was a leading such company. The substitute did not cause economic grave hardship to the companies that had producing the stuff in the first place, and it didn't bring about enormous changes in our way of life. We were able to find other ways of doing hairspray. We didn't need concentrated CFC, as it turned out.

With climate change, from my theoretical point of view, it's hard to find the metaphor because it's hard to find the solution, not the other way around. To do something meaningful about climate change would require action in a much more disbursed way. I mean why are we talking about responsibility and what people understand and don't understand? Most people had nothing whatsoever to do with banning the CFCs. Reagan developed a nasal cancer, as it happens, at the right time to be pursued that ultraviolet radiation was responsible for a rise in skin cancer, and he instructed his delegate to the international negotiations differently from the way that delegate had been instructed before. That was kind of an accidental little political thing that happened. But nevertheless, it was a tiny handful of largely western world companies that needed to find a substitute. That is not the case for climate change. I think we will find the metaphors if we agree on the problem, not the other way around.

Orlove: It certainly is a cycle, but I think there are many loops. I agree with you that we certainly need the big solution. But it could well be that some local acts of mobilization would help.

Jasanoff: Yes. Disburse the solution. I don't think there's going to be a single mega-solution.

A: Is talking about the weather for the purposes of making small talk unique to English-speaking cultures? The reason I ask that is because in France they make a great point that they do not talk about the weather for social purposes. This is something that happens only if—Sheila is Anglo-Saxon. North of France is so close to Great Britain the weather is very similar. Talk about social bonding, but they were both very homogeneous cultures. So I was just wondering, do Inuit talk about the weather for social purposes?

Jasanoff: There's an Oscar Wilde quotation that's in our literature. You know, Oscar Wilde, who, after all, was exiled from England to France and had a more French ironic sensibility about certain kind of things. What does he say—that talking about the weather means you're trying to avoid talking about something else. No, I don't think all cultures talk about the weather at all. For one thing, I don't think weather, as such, is a phenomenon in all geographical locations and places. And the particular British art of talking about the weather, because it is the banal thing—I was smiling when somebody said you don't talk to taxi drivers about politics. I talk to taxi drivers in Washington about politics all the time. That is what they want to talk about, at least as much as about the weather. But with British taxi drivers you talk to them about something else.

Orlove: I will say that people in Uganda do talk about the weather a lot. They don't just say, "Hello." It's a long series of greetings and the weather comes up at a specific point. This Ugandan meteorologist was visiting California on a conference, and somehow with a little jet lag he was about to start asking me about my cattle, but fortunately I said I didn't have any. But he went through the whole family, and recalled that my daughter had a pet rabbit, so he did get to ask about the pet rabbit just in the right order—first the family, then the animals, then the weather. It's what they do, and it's actually useful information to them, but it's also kind of good to keep track of the weather there. It has both a very strong economic importance and a kind of moral importance through ancestors and gods and rain at the right time. If the rain is coming at the right time life's good, and if it isn't, it's a source of moral as well as economic worry.

Jasanoff: Because it's meaning-laden, rather than divorced from meaning—

Orlove: Well, I think we could have a long debate. You get to leave, but we're going to go on and on. I actually think the banality is itself a comment about social life.

Leiserowitz: It would be interesting to know what the cultural history of talking about the weather is. To what extent is it a holdover of when America was predominantly a rural society? Among the Inupiaq Eskimos that I work with weather is vital to life. It's going to decide whether you live or die on a given day, because you have to know what the weather conditions are like. In fact, that's partly why they're so concerned about climate change, because their old patterns of prediction are no longer as valid as they used to be. They're less able to predict their environment than before.

What I'm really struck by in our modern urban world is the extinction of experience. Look at us right now. Look at that little box on the wall. We are sitting in a climate-controlled room. The windows are all closed; we have no connection whatsoever to the outside world. We'll leave from here, most of us will jump into cars or vehicles or whatever, many of which will be air-conditioned. You know what the American lifestyle is like. We go from our climate-controlled house to our climate-controlled car to our climate-controlled office and back. We'll spend a little time maybe taking a hike or going to a soccer game or going to a sporting event that's outside, or taking a walk in the park, but it's the extinction of the physicality of the weather that I think is part of this broader increasing alienation and separation of the human being from the natural world that I think fundamentally underlies so much of all of these environmental problems, not just climate change.

LeMenager: I don't believe in the extinction of the weather. I know what you're saying about the sort of—

Leiserowitz: The experience.

LeMenager: The extinction of experience as well. I think that experience is harder and harder to lay claim to, but the weather constantly erupts into our climate-controlled regimes and constantly reminds us, in fact, of how powerless we really are, and that's why weather is such great news. There's The Weather Channel, there's *Storm Chasers* on PBS. In California if it rains the entire community is up in arms because the roads are slick.

Orlove: Anti-pluvialism.

LeMenager: Yes, anti-pluvialism. I think there's this really interesting way in which the weather kind of trumps and challenges a certain postmodern idea of absolute containment by culture and cultural scripts, and the mechanisms and technologies of culture. So this question of alienation in some ways I think is—I don't know. I don't see that anymore as a question for me, even though I do of course get what you're saying. I'm going to go and get into a taxi after this, as you are.

Orlove: Just to follow, it's perhaps an interesting note that we're struggling for the great climate film. Your point about the weather news is fantastic, and the history of weather news and The Weather Channel, and so perhaps it's come to find its medium and its outlet. The Weather Channel actually has, for a large corporation, some degree of courage in going further out on climate change than many other such corporations might have.

LeMenager: It kind of frantically pursues the weather, as if the weather could be incorporated into this indoor world that we inhabit.

A: Or controlled. We haven't talked about that.

Orlove: If that's of interest to you, stick around.

A: Climate is just one of the changes that human beings have to learn to deal with, and I'm wondering if anyone has a perspective on how well humans can deal with change in general? Are we as good as cockroaches? Because one thing we know for sure is that the weather is going to change. Whether it's human-induced or not, the climate of the earth has changed radically over the years, and it's going to continue to do so. Does that mean if we can't adapt to it that we're going to go the way of the dinosaurs? Or should we more concentrate on learning how to deal with change?

Orlove: Well, it's changed over centuries, and it's now changing over the decades. Humans with much less complex technology—not universally, but generally—have done pretty well with the century sort of time scale. The decade time scale is a much harder one.

A: There have been radical changes. The dinosaurs didn't take too long.

Orlove: Well, that's looking back over a long time, actually. I think it's hard to pick out those years and decades in the fossil record.

A: It's not changing that quickly now, actually either.

Orlove: No, but the dinosaurs might have taken tens or hundreds of thousands of years, but that was 65 million years ago, so we're saying, gee, 65 million years ago they were there, and 60 million years ago they weren't.

A: So do you think we're as good as the cockroaches in adapting to change?

Orlove: Well, we have a wider range of options.