GLOBAL WARMING

White House Enlists Science For Public Education Effort

It's not often that the president and vice president of the United States spend an hour listening to scientists. But last week, in the East Room of the White House, they gave their undivided attention to seven researchers at a seminar on climate change. As the television cameras whirred, however, it was clear that the session was aimed more at educating the public than the nation's top executives.

The hastily arranged session—devoted mostly to the potential dangers in a world warmed by the buildup of greenhouse gases—helped lay the groundwork for a White House conference on global change, scheduled for 6 October, that will explore responses to a changing climate. That meeting, in turn, will set the stage for an international meeting in December in Kyoto, Japan, at which most of the world's nations are expected to sign an agreement setting limits on greenhouse gas emissions.

Although the Clinton Administration has accepted the conclusions of the U.N.–sponsored Intergovernmental Panel on Climate Change—which declared in 1995 that "the balance of evidence suggests that there is a discernible human influence on global climate"—it has yet to formulate a specific negotiating policy for the Kyoto meeting. Nor has it endorsed additional changes in U.S. energy policy aimed at slowing the steady growth of carbon dioxide in the atmosphere—changes that would be fiercely opposed by a slew of powerful lobbies. Instead, the Administration is preparing the ground for the political battles to come. As President Clinton said in a June speech to the United Nations, "to do our part, we first have to convince the American people and the Congress that the climate change problem is real and imminent."

That's where last week's tutorial comes in. The meeting, put together by the Office of Science and Technology Policy (OSTP), the Council on Environmental Quality, and the White House office handling the October conference, featured three Nobel laureates and four other well-known scientists. Each spoke for 3 minutes and then fielded questions from Clinton and Gore in a discussion before 100 invited guests from the Administration and Congress. Chemists F. Sherwood Rowland of the University of California, Irvine, and Mario Molina of the Massachusetts Institute of Technology (MIT) began by describing the mechanisms of greenhouse warming and trends of greenhouse gas emissions—complete with an expandable flip chart showing projected atmospheric carbon dioxide concentrations in the 21st century. Ecologist Jane Lubchenco of Oregon State University in Corvallis (who is also chair of the board of directors of the American Association for the Advancement of Science, *Science*'s publisher) and microbiologist Robert Shope of the University of Texas painted a picture of a United States riven by ecological disruptions and spreading infectious diseases. Physicist Henry Kendall of MIT and climatologist Stephen Schneider of Stanford University explored the possibility of world food crises and stronger storm systems.

J. SCOTT APPLEWHITE/AP

Warming up. Clinton and Gore hear from Molina about atmospheric CO_2 levels in first meeting leading up to Kyoto conference. From left, other seated scientists pictured are Lubchenco, Rowland, and Schneider.

John Holdren, a professor of environmental science and public policy at Harvard University, wrapped up the discussion by addressing a question from Clinton about why people aren't more worried about global warming. Most Americans, Holdren answered, do not recognize the many linkages between the developed world, which has the resources to respond to the problem, and the developing world, which likely will suffer more severe consequences. "You can't sink just one end of a boat," he concluded.

The discussion was not designed to reflect the full range of opinion—no skeptics were invited—but to underscore the need for limits on greenhouse gases. That could be a tough political sell, however. Indeed, the U.S. Senate underscored that point the next day: By a vote of 95 to 0, the Senate approved a resolution introduced by Senator Robert Byrd (D–WV) urging the Administration not to sign a treaty in Kyoto if it would cause "serious harm" to the U.S. economy, or if it doesn't hold developing nations to meeting comparable requirements.

The Senate will have to ratify whatever treaty emerges from Kyoto, and neither of these two conditions will be easy to meet. The most economical way to reduce emissions would be some kind of global emissions-trading system, yet such a system will be enormously complicated and could lead industries to move from developed to developing countries. Moreover, any discussion of what many economists say is the most efficient way to reduce U.S. emissions—to tax energy use and apply the money to lowering other taxes—is a political no-no, say sources in the Administration.

At present, the United States is obligated to meet the goals outlined in the Framework Convention on Climate Change that was negotiated at the 1992 U.N. Conference on Environment and Development in Rio de Janeiro. It requires the developed countries to stabilize emissions of greenhouse gases by the year 2000, while the developing countries agreed to less specific mitigation measures. President Clinton embraced these goals in a 1993 speech, pledging to reduce U.S. emissions to 1990 levels by the end of the decade.

But in the spring of 1996, Timothy Wirth, undersecretary for global affairs at the State Department, and other government officials admitted that they were never going to make that target. Current projections put U.S. emissions at 13% above 1990 levels by the end of the decade, with continued increases for the foreseeable future. And the United States is not alone; most of the countries that committed to emissions limits after the Rio convention will fall short of their goals, which is why the Kyoto meeting is supposed to focus on binding limits.

As it tries to develop a negotiating position for the meeting, the Administration is caught between several powerful lobbies. The industries most likely to be affected by limits on carbon dioxide emissions—transportation, mining, and energy—argue for a go-slow approach. "We believe there is no need to rush into a treaty until people have better information," says Gail MacDonald, president of the industry-sponsored Global Climate Coalition. "The analytic work says that we have a decade to deal with these issues."

Environmental groups have been arguing just the opposite, saying that the only reliable "no regrets" policy is immediate action. "As long as the uncertainties are so high, we should not commit ourselves to a future that could turn out to be catastrophic," says Michael Oppenheimer, senior scientist at the Environmental Defense Fund. "We should try to find an emissions pathway that does not foreclose keeping concentrations low." For Oppenheimer, that would be significant reductions below 1990 levels starting no later than 2005.

Faced with these political conflicts, the Administration has been quietly sounding out scientists to help it develop its position. At the State Department, the lead agency in

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preparing for Kyoto, Wirth has been hosting a monthly seminar on environmental issues that is often focused on global change. Briefers have included National Oceanic and Atmospheric Administration climatologist Dan Albritton and economist Robert Repetto of the World Resources Institute. OSTP also has been holding briefings for policy-makers struggling to respond to the data. "The issue now is not so much whether we have a problem," says presidential science adviser and OSTP director Jack Gibbons. "It's what to do that's sensible and effective."

The Administration has been getting input from other sources as well. The U.S. Global Change Research Program and OSTP are holding meetings to discuss the regional impacts of global change in an effort to fine-tune the analysis of global warming. "We can now take what we've learned on a global scale over the past decade and focus that research on regional scales," says Robert Corell, head of geosciences at the National Science Foundation and chair of the federal interagency committee that coordinates global change research.

Filling up. A steady rise in carbon emissions from all sources is fueling calls for binding limits.

The President's Council of Advisors on Science and Technology (PCAST) is also involved. It held a meeting on 9 June during which the president and PCAST discussed global change, and since then a panel headed by Holdren has been preparing a report on U.S. energy research and development during the next half century that is due by 1 October—just in time for the planned White House conference. A similar meeting held during the Bush Administration ended in disarray after squabbling over uncertainties in the science and the best ways to limit emissions. This time around, say Administration officials, greater consensus over the science should make for a more harmonious gathering.

If so, it would help the Administration meet what many scientists and government officials agree is the most important immediate challenge: making a strong case to the public. "The American people still need to be convinced," says William Schlesinger of Duke University. "It's a very skeptical jury out there."

–Steve Olson

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BIOTECHNOLOGY

Transgenic Lambs From Cloning Lab

Just 4 months ago, a lamb named Dolly became an instant celebrity: She is, of course, the first animal ever cloned from the cells of an adult (*Science*, 7 March, p. 1415). Virtually unnoticed at the time, however, was the birth of three other lambs cloned from fetal, rather than adult, cells. But they may have more practical import: In a big step toward developing domestic animals with designer genomes, the Roslin Institute of Edinburgh, Scotland, and the Scottish biotechnology company PPL Therapeutics—the two institutions that cloned these lambs—have now combined the fetal-cell procedure with genetic engineering.

On 24 July, they announced the birth of five more lambs cloned from fetal cells. What distinguishes this new bunch from Dolly and her cohorts is that these animals carry extra genes—a few even have a human gene—that the researchers introduced into the cells before they were cloned. PPL has refused to disclose the identity of the human gene, but researchers say the achievement could aid efforts to develop livestock that produce human proteins, such as blood-clotting factors, for therapeutic use. Although other technologies have been used to create domestic animals that carry such human "transgenes," they are both time-consuming and have a low success rate. "This is a big deal," says Randall Prather, an embryologist at the University of Missouri, Columbia. "It's a way that we can finally make transgenic [domestic] animals efficiently."


JOHN CHADWICK

Transgenic lamb. Polly, who has a human gene, was cloned from fetal cells.

To make the new set of animals, the Scottish team, led by Roslin embryologist Ian Wilmut, first exposed fetal skin cells called fibroblasts to DNA that included both the human gene they were trying to transplant and an undisclosed marker gene. After eliminating cells that didn't express the marker gene, the researchers tested to see which of the remaining cells also took up the human gene.

Wilmut's team then followed the same cloning strategy they used to make Dolly. They first removed the nuclei from mature egg cells and used a brief electrical pulse to fuse the enucleated eggs with the engineered fibroblasts, which had been starved of nutrients. The pulse also jump-started the developmental program—with the genetic instructions now coming from the fetal-cell DNA. In the final step, they placed the eggs in ewes to develop.

The team used fetal cells and not adult cells because the fetal cells have been more efficient in getting an egg to develop, resulting in about one live birth for every 60 nuclear transfers, says Wilmut. The team has achieved about the same success rate with genetically engineered cells, he reports. All five of the new lambs carry the marker gene, and one—named Polly—has already proved to have the human gene in her cells, although the Scottish team has not demonstrated that the gene is expressed. Two more lambs came from cells carrying the human gene, but the researchers have not yet confirmed that the gene is in those lambs.

The birth of Polly already proves, however, that the foreign DNA in the fibroblast genome did not disrupt the genetic instructions that guide the lamb's development. "That is important," says George Seidel, a physiologist at Colorado State University in Fort Collins. In addition, the procedure seems to work in pigs and cows. Steve Parkinson, president and CEO of Advanced Cell Technology in Amherst, Massachusetts, says his company has been using genetically altered fetal cells and nuclear transfer technology to produce cow and pig fetuses whose nerve cells are collected for possible use in treating Parkinson's disease. The company is now allowing some fetuses to proceed to term and expects to have newborns later this year, Parkinson notes.

The technique should facilitate the development of animals with customized genomes, including those that have had genes knocked out as well as added. The procedures could help, say, in improving prospects for xenotransplantation by removing immunogenic proteins from pigs whose organs would be used for replacing ailing human ones.

Some experts caution, however, that it will be some time before these procedures make their commercial debut, because lengthy and expensive clinical trials will be needed to show that the proteins or cells produced by these animals are safe and effective. But Wilmut is optimistic, in view of the rapid progress so far. "We're pleased that we got to this stage so quickly," he says.

–Elizabeth Pennisi