"POLICY, POLITICS, AND SCIENCE IN THE WHITE HOUSE: CONVERSATIONS WITH PRESIDENTIAL SCIENCE ADVISORS"
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DR. PIELKE: Good evening. Thank you for coming out tonight for a romantic evening. This is the kick-off event in our year-long series "Policy, Politics, and Science in the White House: Conversations with Presidential Science Advisors." I am Roger Pielke, Jr., from the University of Colorado, and we are extremely pleased tonight to welcome Jack Marburger, who is Science Advisor to President George Bush.

With any year-long series, we will bring five science advisors to Boulder. It takes the support of a wide range of groups. I would like to acknowledge the support of the Cooperative Institute for Research in Environmental Sciences here at CU, the graduate school, and Office of the Vice Chancellor for Research, the Provost's Office, the College of Engineering and Applied Science, and the College of Arts and Science's Dean's Fund for Excellence.

We also have support from some groups outside of CU; Southwest Research Institute, Colorado School of Mines in Golden, and the Boulder-based ICAT Managers.

Any event like this requires the work and dedication of a number of individuals. I would like to thank a couple of people in particular. Bobbie Klein, who is the managing director for the Center for Science and Technology Policy Research. She conceived of this series and helped bring it from an idea to reality. Ami Nacu-Schmidt made everything work just wonderfully for this. There are a few other folks who you will see working on this that they know who they are and their contributions have been very important.

On a more somber note, our second Science Advisor who was attending, D. Allen Bromley, who was Science Advisor to George H.W. Bush from 1989 to 1993. He was scheduled to appear next month. He passed away last week, and we send our condolences to his family and friends.

We would like to encourage you to visit our website, which has a lot of material on the Science Advisors and a on-line library with information about science and politics at the highest levels of government. And eventually you will be able to find a transcript of tonight's forum along with a streaming video, so please check out the website, which you will find in your program.

And mark your calendars for April 11th. We are going to have a former Chief of Staff of the House Science Committee, Democratic Office Bob Palmer, who will be giving an afternoon lecture.

So now on to our main event. Tonight we have a three-part format. First, Dr. Marburger will be invited to give remarks for about fifteen to twenty minutes,

and while he is giving his remarks, we would like you to think about a question that you may want to ask him. Obviously, we're not going to get to all of the questions tonight, but use the note card that's in your program, write it down, and when Dr. Marburger is finished with his remarks, we will have some folks coming along the aisles to collect your questions. We'll try to get through as many of those as possible in the third part.

The second part of the format, Dr. Marburger and I will recline on the chairs here and I'm going to interview him and ask him some tough questions and have a discussion about science policy.

And then the third part will be your questions, and we will get to as many of those as possible.

So let me now introduce Dr. Marburger. On June 25th, 2001, John Marburger was nominated by President Bush to serve as the Director of the Office of Science and Technology Policy in the Executive Office of the President. This position is otherwise known as the President's Science Advisor. He was confirmed by the Senate on October 23rd, 2001.

Before assuming his present position, he was Director of Brookhaven National Laboratory and the President of the State University of New York at Stony Brook. Prior to his time in New York, he was on the faculty of the University of Southern California, where he was a professor of physics and electrical engineering, chair of the physics department and Dean of the College of Letters, Arts and Sciences.

So it is with great pleasure that I welcome Jack Marburger to Boulder and the University of Colorado.

DR. MARBURGER: Thank you, Roger. Before I make my prepared remarks, I would like to acknowledge the contributions by one of my predecessors, D. Allan Bromley. Roger mentioned this. Allan was the advisor to George H.W. Bush and he was a friend. He died of a heart attack last week at Yale, where he had continued to lecture after many long years -- many long years after the rest of us would have retired. Allan enjoyed his role as a science advocate, and he spoke fearlessly on behalf of science and its needs. I think he reflected accurately the feelings of many scientists, and won their admiration for his defense of basic research. Allan wrote well; some of you may have read some of his sonnets and some of his writings. He wrote a book, or a couple of them I think, after his stint as Science Advisor.

When President Gerald Ford sought to create a statutory foundation for White House science advice in 1976, Congress responded with an impressively broad mandate. There is a Public Law, 94-282. The new Office of Science and Technology Policy was to advise the President, and by implication, the Executive Office, coordinate science policies and budgets among federal agencies and with the private sector, build partnerships with the science community and federal, state, local, and international governments, and forecast and evaluate the federal science and technology enterprise.

That is a tall order for a relatively small staff office within the White House. But OSTP does have access to powerful resources, and the challenge is not so much in meeting expectations with limited resources as determining what precisely is the effective content of all of this advice, coordination, partnershipping, forecasting and assessment? What specific things can OSTP do

that will make a beneficial difference in the course and societal impact of U.S. science? It's a question of content. What can you do in an office like that?

For many reasons, this turns out to be a difficult question. There is no job description for science advisor, no one to say how to carry out the mandate from Congress or how to engage the machinery of the White House to get things done.

As we begin our conversation this evening, I will make a few remarks about history, and then I'll draw your attention to two commentaries, one old and one new, that frame the challenge of science advising and give some clues as to how one might go about doing it. So let me do the historical part.

Thomas Jefferson launched federal science two centuries ago with his commission to Lewis and Clark. Territorial expansion and the industrial revolution continued to drive U.S. science and technology policy, such as it was in those days, throughout the 19th century. The two World Wars and their aftermaths were primary factors in the 20th century. Among these varied influences, World War II stands out as a unique turning point in this history. Our attitudes today toward government's role in science were formed during the 1940s, and the institutions that support this role were largely in place by 1950, which is the birth date of the National Science Foundation.

The larger Department of Energy laboratories were already in place by then under the Atomic Energy Commission, and each of the military services had an official research office by 1951. In 1951, 1950, NIH had existed for 20 years; much older than those organizations. NASA and ARPA or DARPA came eight years later. Some reorganizations did occur after 1960, notably the metamorphosis of the Atomic Energy Commission into the Department of Energy, picking up some other responsibilities along the way, and, of course, the creation of the Department of Homeland Security most recently in the first administration of our current president.

But since 1960, the federal framework has really evolved very little for science. The 1940s and `50s were obviously very busy years for science advisors, for whom the archetype during this period was Vannevar Bush. During the war, the science advisors linked the President and top government policy makers with the nation's technical infrastructure in universities and industry. And within the White House, they filled gaps in technical knowledge of the rapidly developing fields of science that would strongly influence the course of the war, transform the nation's economy in its aftermath, and revolutionize society following the disintegration of the Soviet Union in the century's last decade.

The early Presidential science advisors came from a small group who had played important roles during the war, including the Presidents of Bell Labs, the president of MIT, and Caltech, and scientists who were active in the Manhattan Project or other wartime ventures. And the unambiguous focus of science advice during that period was military preparedness.

Well, the advisory arrangements have changed relatively little since 1960. Presidential science advisors are still mostly physicists, known to each other, and national security is still an important focus of science advice with a new Homeland Security angle.

Given the enormous changes that have occurred in the landscape of science and the technical infrastructure of society, this invariance of the government machinery for science is mildly surprising. It speaks, perhaps, to the wisdom of

the postwar policy architects, but it should also awaken a concern that the structure and practice of science policy today may diverge from the functions it needs to perform in a dynamic society, which I presume is one of the reasons we have organizations like the one that is studying science policy in this institution.

Stability versus change is a theme of two of my favorite science essays on science policy. These essays lie at either end of this history of postwar technological growth and so I'm going to talk just briefly and quote some from these papers and then we can get to our conversation.

At the near end, the close end, at this end of this history of science advising, is an essay by Daniel Sarewitz. I don't know if it's published anywhere, but it is on his website. Daniel Sarewitz, in 2003, wrote an essay called "Does Science Policy Exist, and if so Does it Matter?" which is quite a remarkable title and it's a delightful essay. It is available on the website of the Consortium for Science, Policy, and Outcomes at Arizona State University, and you can Google that.

At the far end, early, at the leading edge of the dramatic leap in federal science funding in the early `60s, is Alvin Weinberg's 1961 Science Magazine article entitled "Impact of Large-Scale Science on the United States." This is the essay that defined and launched the concept of Big Science, but it also suggests, almost implicitly, how one ought to think about priorities for federal science.

I want to show you some view graphs of the history of federal science, which are quite striking. Here is, in constant 2000 dollars, a picture of the federal spending on research and development from 1949 until the present. Constant dollars. This includes defense R&D, which lately has been large. I'm going to put up a similar graph showing non-defense R&D, which looks similar but there is some important peaks that are pronounced and that I wanted to draw attention to.

You can see where Alvin Weinberg was writing about here, and Dan Sarewitz was writing here. This is the Apollo program, this bump, this is some spending in energy-related research after the first Arab oil embargo in 1973, these are the Reagan years in here, and this line is where George W. Bush became President. This is an extraordinary curve. Of course, a lot of this the doubling of the NIH budget, this big peak here, but not all of it. Actually, a lot of people aren't aware of this, but there was an extraordinary jump in science -- non-military science spending during the first four years of the Bush Administration, which puts us up at a peak at 2005-2006 budget request, looks like it is down a little bit here, but it is still quite high compared with historical averages.

In his 2003 essay, Sarewitz points out the remarkable stability -- it looks like a mountain range here -- Sarewitz points out the remarkable stability of federal R&D funding as "a fraction of domestic discretionary budget over four decades," except for the bulge of the Apollo moon program. Since 1961, omitting Apollo, non-defense R&D spending has fluctuated slightly above or below a constant 11%. In fact, this year's budget request by the President is exactly on a 30-year average, and this shows a 30-year average, non- defense R&D is a fraction of the domestic discretionary, but this is the pot that Congress actually divides up and it's extraordinary that it's so constant. It's just amazing. Here is one that actually goes for 40 years and it has got a 10% line drawn on it and you can see how constant it has been.

These are the same figures, but they go back earlier to the beginning of the Apollo period. It turns out that when you take out the Apollo program, it's practically constant for that entire period.

"This stability," and now I'm going to quote Sarewitz, "This stability is particularly amazing given the Balkanized manner in which science budges are determined. The first thing to note here is that there is neither a capacity nor an intent to undertake centralized strategic science policy planning in the U.S. The seat of American science policy in the Executive Branch is the Office of Science and Technology Policy, whose director is the President's science advisor. The influence of this power has waxed and waned with time," and Dan says mostly waned. That's a plausible assumption, but it's slightly too simple. Returning to quoting Dan again, "but it never exercised significant influence over budgetary planning. That influence came from the Office of Management and Budget [OMB] ... which solicits budgetary needs from the many Departments and Agencies that conduct R&D, and then combines them for reporting purposes into categories that could be considered to reflect a cumulative R&D budget - but the process is largely bottoms-up. The situation in Congress is even more decentralized, with numerous authorizing and appropriations committees in the Senate and House each exercising jurisdiction over various pieces of the R&D enterprise. Moreover, the jurisdiction of the authorizing committees does not match that of the appropriations committees; nor does allocation of jurisdiction among Senate committees match those of the House committees. Finally, the appropriations process puts S&T agencies such as NSF and NASA in direct competition with other agencies such as the Veteran's Affairs and Housing and Urban Development."

This is a little sharp, but it an excellent short summary of the science funding process. It omits the additional complexity of the competition that science faces within its own departments - a department like the Office of Science and the Department of Energy, which has clean-up budgets and national security budgets and other things. And it ignores the fact that the OMB process is not just one of combining requests from Departments and Agencies -- that process includes significant policy decision-marking and prioritizing. But it does capture the decentralization and fragmentation of the process that makes the stability of the science share of the domestic discretionary budget pot all the more remarkable.

After I show this figure of the Science Policy Conference celebrating Neal Lane's 65th birthday a couple of years ago, Allan Bromley confided that he had been surprised by this remarkable invariance. He had not been aware of it. It's something that a lot of people don't seem to be aware of. It's quite, quite interesting to me that given all of the tug and complexity that we have this remarkable constant share of the available pot going year after year to science -- non-defense science.

This brief analysis suggests one answer to the question of what science advisors need to do, and that is to engage the budget process. In the Bush administration, I have been blessed with two OMB Directors, Mitch Daniels and Josh Bolten, who included me in the policy levels of budget deliberations. In today's OSTP, we set our work schedule and products deliberately to synchronize with the budget cycle. According to long time OMB staff, OSTP has unprecedented input in the budget process and in the language of the budget itself. But this is beside the deeper and somewhat mysterious point of the stability of the science share of discretionary spending.

Within this relative stability of overall domestic budget market share, the fortunes of science have shifted considerably among fields. It's a popular graph compared by the American Association for the Advancement of Science, which shows the major trends that have defined post-war science since Apollo, or actually since the time before Apollo. This is a famous graph; many of you have probably seen this graph. It is by field. The yellow is NIH, or health, the blue is NASA -- there's the Apollo program. NASA has been relatively constant, actually, and then everything else is energy in green and there's a little peak there in the post-70 -- mid `70s period.

Three major trends have defined the post-war science. The 15-year Apollo hump, starting at about 1960, the post-Arab oil embargo energy research bulge in the mid-`70s, and the inexorable rise in the NIH budget, culminating in the five year doubling period ending in 2003. And I agree with Sarewitz that "it is not only axiomatic but also true that federal science policy is largely played out as federal science budget policy" and it is clear from the mega-trends that the policy is impelled by societal issues external to science. So you can sort of see some of those factors there.

The stability of market share that Sarewitz noted began only after an abrupt adjustment following the launch of Sputnik in 1957. You can see it shoot up there. Federal non-defense R&D outlays rose by a factor of ten in constant dollars in the five years following 1958 -- just an extraordinary increase. And this was when Alvin Weinberg wrote the second of my favorite science policy essays. Weinberg's rhetoric opposes big and small science, but his real point is that the likely societal impact of different areas of science are different, and we should acknowledge this and use it as a funding criteria. For example, investments in health research will probably have higher returns to society than investments in astrophysics. In Weinberg's day, the big sciences were space exploration and high energy physics. He lived -- he was writing right here when the massive budget was going up exponentially. And, of course, it was not only NASA's budget, Weinberg himself was director of Oakridge National Laboratory at that time, and he was watching a big accelerator project get built at Berkeley, at Brookhaven, and one was being planned at that time at Stamford and also the early stages of planning for what is now Fermi Lab, and he was watching these big accelerators swell. And so in his day the big sciences were space exploration and high energy physics. Today, the need for expensive equipment in many applied fields, like x-ray synchrotrons, has blurred the significance of bigness in Weinberg's argument. There is a lot of big science now, not only in those areas. But it has not diminished the need to understand the likely impact on society of different patterns of investment.

Here are Weinberg's own words on this matter. He says "It is presumptuous for me to urge that we study biology on Earth rather than biology in space, or physics in the nuclear binding-energy region, with its clear practical applications and its strong bearing on the rest of science, rather than physics in the Bev region, with its absence of practical applications and its very slight bearing on the rest of science. What I am urging," said Weinberg, "is that these choices have become matters of high national policy. We cannot allow our over-all science strategy, when it involves such large sums, to be settled by default, or to be pre- empted by the group with the most skillful publicity department. We should have extensive debate on these over-all questions of scientific choice: we should make a choice, explain it, and then have the courage to stick to a course arrived at rationally." That is a plea for rationality in science funding in a very chaotic and perhaps irrational context.

I think that one of the important roles of National Science Advisors is to try to introduce these kinds of considerations into the complex process of requesting and appropriating resources, and not simply to be an advocate for everything that any scientist wants to do or to go along with societal inclinations that may be shaped, as Weinberg put it, "more by public relations than by relevance to society." The extraordinary flowering of technology in the post-World War II period has produced an enormous frontier of opportunity in science fields that are strongly linked to societal needs. They are not all applied science, either. Some of them are very fundamental basic discovery-oriented science areas. The expense of pursuing these makes Weinberg's plea even more appropriate today than forty years ago.

So science policy and science budget-making occurs in a very complex and chaotic context, but there are some things -- there are some things that science can do for society that we need to pay attention to. We need to pay attention to the division of our resources and the allocation of our national assets among these fields, and it is possible for science advisors and science advocates to bring these concepts into the arena and introduce them into the public debates and try to make rational decisions and a rational recommendation based on it.

I hope that some of these themes will be teased out in the subsequent conversation and perhaps in response to your questions. I look forward to talking with Roger and with you, and I urge you to continue to support this series through your attendance and hear what some of my predecessors have to say about their jobs in the Office of Science and Technology.

So let's get to it, Roger, after that little introduction.
(applause)

DR. PIELKE: So this would be the time to pass your note cards to the aisle. Let's start with the simple question about what the Science Advisor does. Can you tell us a little bit about what your interaction with the President is like, and maybe give us an example of a situation when your advice was called for?

DR. MARBURGER: Well, what do I do? I do a lot of very different things. I talk at conferences like this, and meetings, I interact with the other scientists in government and the Agencies, but science enters into policy-making in a sort of a hierarchyable fashion. Most of the decisions that really have technical content get made within the government agencies at a level far below the White House. And it's only rarely that science issues, or issues with technical content, actually come up to the White House for decisions or for policy directions change, but probably the most common way they come up is in the budget process, and that's where a lot of the discussions that I have with my colleagues takes place.

What I actually do is I begin my day every morning with a meeting with the Senior White House Staff. We talk about events that are very current day- by-day salients and I offer whatever comments I can make about science, but usually science is not part of those salient issues.

Rarely, but on important occasions, issues do come up where the President has to make a decision about something that has a technical component. And in those cases, my office helps me to prepare briefing documents that I share with my White House colleagues. We decide if there is any controversy or difference of opinion, try to work those out to the extent that we can, and leave the remaining items for the President to decide on. This is the policy process, policy coordination process, within the White House.

And so most of my interactions where advice is given occur in this formal context with briefings for the President that are prepared in cooperation with other policy offices in advance, and usually reflect very substantial input from the Agency or the Department that is responsible for that area. For example, when the Department of Energy was ready to recommend -- make a recommendation about Yucca Mountain, whether the nation should move ahead to develop and open Yucca Mountain for the storage of nuclear waste or nuclear radiological material. The Department of Energy prepared some materials, I reviewed it with my office, we sat with other relevant offices, like the National Economic Advisors' Office, and then sat with the President and gave him the range of options and he made the decision at the meeting. That's an example.

Another different kind of briefing was after the recent Tsunami that devastated so much of the periphery of the Indian Ocean just after Christmas last year. The President was interested in Tsunamis and how they worked and what caused them and what a warning system would look like in preparation for a decision that he made about how America should participate in the international response to that terrible disaster.

DR. PIELKE: Earlier today, in one of our meetings, you mentioned a story about your first weeks on the job when the Anthrax situation came up. OSTP took on more of an operational role. Can you tell us about that?

DR. MARBURGER: Yes, it's rare for -- I mean, OSTP is a staff office, not a line office, and the dollars for doing things in federal government are appropriated to the Agencies and to the Departments to spend in organized programs. And the staff offices rarely have an operational function. But in the days and months after 9/11, there were issues of an immediate concern that arose. The U.S. Postal Service, for example, had no idea what to do with the contaminated letters. There were boxcars full of them that had been contaminated in their processing machinery by Anthrax spores, and OSTP actually assembled a team of experts from the different agencies like the FDA and NIST, I believe, had a representative, and a number of other areas: the Department of Energy and areas that had expertise in Anthrax and in the sterilization of spore-forming bacteria.

And we actually advised the U.S. Postal Service on what they should do. So that's sort of an operational role that we try not to do. We try not to have programs -- sometimes Congress wants us to have money that we spend on getting things done. I try to avoid that. We try to have the money go to the Agencies that have the staff to do that. I have a relatively small staff. It's about 60-65 people, but we are spread quite thin over all of the areas of science and technology.

DR. PIELKE: So, the President has been known to give people nick-names. Do you have a nick-name?

DR. MARBURGER: My nick-name has been Jack since I can remember, and that's what the President calls me too.

DR. PIELKE: Observers of the Bush Administration have made much of the fact that during his first term, your offices, the Offices of Science Technology Policy, were moved farther from the West Wing of the White House. So, OSTP was further from the President than other Executive Offices of the President committees and further than the Science Advisor had been in the past, and this was interpreted as being reflective of a diminished role for science and

technology advice in this administration. But at the same time, President Bush's Chief of Staff, Andrew Card, said last year that you were "closer to pulse of the White House than any of his predecessors." So, to us on the outside, this seems kind of contradictory and I wonder if you might clarify it?

DR. MARBURGER: I guess I would listen to Andy Card. You know, we were in the old Executive Office Building in the wing that faced 17th Street. It's the only wing of the White House complex that faced an open street. The whole wing was evacuated because they were concerned about truck bombs on 17th Street, and it is currently being renovated. The whole thing is empty right now.

We were moved out into very excellent quarters about a block and a half away, and I must say they were much better quarters than the old Executive Office Building. I hate the old Executive Office Building because it's all cut up into pieces, and in an organization like ours, we work in teams on inter-disciplinary problems and issues that come up, and it's important for our people to be able to interact easily. It is very difficult for team work among different offices within the Executive Office Building the way the space is cut up. So, we were moved temporarily into an office building, a non-federal office building, for a couple of years while space was made available for us in the new Executive Office Building, which is right up 17th Street across the street from the White House. That's the building where some of my predecessors were. I think Jay Keyworth had his offices there through the Reagan era. So, it has been a traditional home for OSTP, and I always thought that would have no bearing. I don't think that where we are makes much difference. We are not, after all, in a day-to-day support mode for the President. The President needs people close to him who will support his activities during the day every day as he is challenged. That's not -- science is not a necessary part of that on a day-to-day basis. The time scale of science advice is much longer than that, and we tend to work out science issues with the other staff of people and the Agencies long before they every get to the President.

DR. PIELKE: So, you were nominated in June 2001 and confirmed in October of that year, and President Bush announced his compromised policy on stem cell research on August 9th. I was wondering what role, if any, did OSTP or you personally play in the development of that compromised stem cell policy?

DR. MARBURGER: Well, at that time, OSTP had -- it was before I got there. I was not part of that. I believe that OSTP may have provided some information, but in general was not in the loop on that process as far as I know.

DR. PIELKE: You have been quoted from the New York Times as saying "no one will know my personal position on issues so long as I am in this job. I am here to make sure that the science input to policy- making is sound and that the Executive Branch functions properly with respect to its science and technology missions." And it is widely known that you have announced yourself as a life-long Democrat, so can you explain a little bit to us about the role that politics plays in the science advisor position? It is a Presidential nominee. Is politics less of a consideration for the science advisor than other high-level appointees or, alternatively, should it be?

DR. MARBURGER: Well, yes, politics is less of an issue for the science advisory role. Actually, you know, science enjoys very broad bipartisan support in Congress. Both Houses, both parties, and it always has. You don't find people bad mouthing science in Congress. Getting something done about the distribution of resources of allocation of new funds is another matter, but in general science is not regarded as an essentially political issue in Congress, and I

don't think it should be. I think it's very important for science advisors, the science advisory apparatus, and the image of science to be as non-political as possible.

DR. PIELKE: I'd like to turn to some specific issues, and I am going to start with climate change. In addition to the University of Colorado, Boulder is home to a large family of NOAA Labs, NCAR, and considerable NASA-sponsored research and development. It is, in short, one of the world's top locations for climate research; there's a lot of interest here. The Bush Administration made clear, in March of 2001, that it wasn't going to participate in the Kyoto Protocol, which actually goes into effect the day after tomorrow. The President's spokesman said at the time "the President has been unequivocal. He does not support the Kyoto Treaty. It exempts the developing nations around the world and is not in the United States' economic best interests." This decision was announced before you were nominated, and the President's rationale does not appear to rely on scientific judgment; at least climate science judgment. What I would like to ask is what is the Administration's position on climate science? And does the Bush Administration accept the conclusions of the IPCC and the National Research Council, and what role does scientific judgment play in the Administration's climate change policies?

DR. MARBURGER: Well, first I think it's important, although you didn't ask the question this way. I think it's important to try to separate the Kyoto Protocol from science climate -- from climate change policy. The Kyoto Protocol has become symbolic in some sense, and somewhat separated from actual actions that have to be taken. The President -- this was sorted out by the White House and the Cabinet in the months before -- even before I became nominated for the position. But, I was impressed. After the President announced that he would not support the Kyoto Protocol early in 2001, there was a lot of criticism and the President turned to the National Academies and asked them to make a study, which they did in record time, informing him about the validity of the science in the documents that supported the Kyoto Protocol. And before his first trip to Europe in 2001, in July, I guess, or June, the President made a speech to which I commend to all of you. You should go on the White House website and look at the President's speech of June 11, 2001 where he states what the policy is very, very clearly. And he states in his speech, number one, the climate is changing, the surface temperature of the earth is warming, there is a greenhouse effect, Co2 is a greenhouse gas, it has increased substantially since the beginning of the industrial revolution, and it is caused by human activity. He goes on to say that the connection between this massive increase in Co2 and specific aspects of climate change that may impact humans is difficult to infer from the existing things. It requires modeling, the Earth's system. But, he goes on to say that is no reason not to take action. He says the U.S. is prepared to take responsibility for its emissions, and he announces the formation of two programs: one climate change science program, which re- focuses the climate change science activities that had existed there before that, into a sort of a goal- oriented program, and a second one, which is very little acknowledged but which is more important, to invest in a climate change technology program to develop technologies that will replace our existing energy technologies and reduce or eliminate the emission of Co2 into the atmosphere. All of those things are in the speech, and subsequently he has made proposals that have turned into approximately $2.9 billion dollars per year of investment in new technologies to reduce or eliminate the emissions of Co2 into the atmosphere. And yet people can talk about nothing but the Kyoto Protocol, and I think that's very frustrating to him. It's frustrating to me, because if the provisions of the Kyoto Protocol were totally implemented, even if the U.S. participated, it would make negligible difference to the climate by the end of this century that

we're currently living in. In order to make a difference to the climate, you have to introduce a very different way of generating and using energy than we do now. There simply isn't any way to do it. You have got to change things very dramatically. We have a very big job ahead of us. Every country is going to have to use new technology, either to remove the Co2 from emissions from hydrocarbon burning power plants or to use some other way, some alternate method, of energy generation. So, this is what we have got to do and I think that we should get on with it and not get hung up over the Kyoto Protocol.

DR. PIELKE: I got to follow you around today and watch you talk to graduate students and professors and administrators, and there were two topics that came up over and over: one was space policy, which we'll talk about in a little bit, and the other was climate change. If you have a community like Boulder, which is climate central and there is difficulty in getting this message that you're saying out, what is the future for the next four years on climate change like under the Bush Administration?

DR. MARBURGER: Well, I think we'll have to wait. I think perhaps the international conferences that are coming up, there is a G8 meeting, I think that there will be opportunities for the President to say what he intends to do. I don't have -- I mean, I can't talk too much of words in the President's mouth, but it is pretty clear where he has been and his commitment to this approach to taking responsibility for Co2 emissions is impressive to me. And I think that we ought to take advantage of the fact that we have a President who is willing to make and to advocate for that kind of investment, whatever we think about the details of the relation between Co2 emissions and actual climate change.

I would like to add just one thing of a technical nature here. I was always rather puzzled at the use of the global annual average temperature as an indicator of the impacts of climate change. Now, I admit that that's a very important parameter and it's something that you can extract from the climate change models -- the global circulation models -- but you know what really is important are the impacts on people in localities and specific places around the globe. The climate is changing, the Earth is warming, and we have to prepare for that and it would be nice if we could get better advice to people than we are currently able to give and not just tell them that the temperature is going to go up by this much or that much in the future. So, I do think that there is an important role for additional research on climate, but it need not prevent us from taking actions that this Administration is, in fact, taking to reduce or eliminate Co2 emissions.

DR. PIELKE: One of the discussions on climate change talks about the role of science affecting politics, like our discussion right now. But, I would like to ask you about the political debate on climate change, how that affects science? My personal opinion and in my writings I have argued that climate science is fully politicized, where every research finding that is put out is interpreted in the context of this political debate that's out there. Agencies put out press releases, scientists put out press releases, every bit of climate science is seen as a bit of ammunition for a political agenda. My questions for you are do you agree with interpretation, and, if so, is there any advice that you might give about the science to the climate science community about participating in climate politics?

DR. MARBURGER: Well, you know this discussion occurs on two levels. I think climate science is actually pretty healthy. There are a lot of people doing good work. There is fairly significant investment; I think it's close to $2 billion a year going into climate science, or global change science, and I think

that's important. And there is very good science being done, and in general the climate science community is not politicized in that sense. On another level, the public perception does appear to be somewhat politicized. It certainly came up as a campaign issue, or there was an attempt to make it a campaign issue last year, but I think that climate change science is pretty well organized. It is a mature area where there are a number of different groups which have significant capabilities for doing the modeling and the data gathering that's important, and I think that we'll see a fairly healthy environment for climate science on into the foreseeable future. This is an issue that's going to be with us for a long, long, time and frankly I think that the science community is handling it pretty well. Most scientists are not engaged in political debate, so I'm pretty proud of the science community on that score.

DR. PIELKE: Climate policy is as much about non-scientific issues as it is about scientific issues; some would say more about that. For example, it is wrapped in U.S.-Europe relations, international trade policy, and as you mentioned, it is a symbol -- an important symbol about environmental values and so on. How do you, as Science Advisor, handle an issue that is only a little bit about science even though the debate is played out in science, but it has all of these other factors wrapped up in it, and presumably the Kyoto Protocol, and we are talking about it again, is discussed in other committees and organizations in the White House besides just the Science Advisor's. Do you interface with these other groups, or how does that play?

DR. MARBURGER: Yes, I do. And, you know, the most important thing for a science advisor to do, is to make sure that the science actually gets into the discussions. I mean, not necessarily to get into anybody else's business, whether it's foreign relations or economics or something else, but to say "hey you guys, these are the facts, so take it from me or ask the National Academies if you don't believe me, but this is the way it is and you've got to know that as you move forward and make your decisions." My responsibility is to make sure that the President and his other policy advisors are aware of what the best science really is saying. And so that's about all you can do, because, in fact, there are other issues that enter into -- economics, for example, of how you respond to the challenge of Co2 emissions really has a lot to do with economics. You've got to understand what is the potential impact of regulating or of investing in some alternative form of energy and what will the impact be on the economy? And those are questions that I can't answer, but I can certainly say what the status of the climate change science is and what it is not. So we try to be the honest broker -- not even a broker. We try to inject the reality as science understands it into these issues no matter who is making the decision.

DR. PIELKE: I want to shift gears now and I want to talk about the issue of the misuse of science, and if there was another topic that came up repeatedly today, it was the misuse of science. And, just a little background for folks, more so than any administration, the Bush Administration has been criticized for the "misuse of science." I put that term in quotes because it is not defined. Examples of this criticism include a series of reports by Congressman Henry Waxman and the Union of Concerned Scientists. Making matters complicated from the standpoint of us outside observing these allegations being made is that Congressman Waxman is a Democrat and the Union of Concerned Scientists is an advocacy group that supported John Kerry in the recent election.

You were widely quoted on this issue and prepared several documents -- one quite lengthy -- in response to these allegations that strongly defended the Bush Administration. First, I'd like to give you a chance just to offer your

thoughts on the allegations by the Union of Concerned Scientists and your response?

DR. MARBURGER: Well, you know, I didn't like the allegations. I thought they wrapped up a large number of disparate complaints into a, what I called at the time, a conspiracy theory. And that was my biggest objection. I just didn't think it made sense to wrap all of these things up into one big ball and try to draw a conclusion from it. It was not a scientifically -- it was certainly not a study that would have qualified for a good grade in a college seminar. It was not a thoughtful or complete study in any sense, and my response to it was an effort to indicate that there were lots of other things that were omitted from that study and that we needed to address these issues one by one in their context and try to understand them and deal with them. They were all over the map, and I was just offended by the statement. So, that's about what I have to say.

DR. PIELKE: Let me ask you an open question, then. What is a misuse of science? How would we know it if we saw it?

DR. MARBURGER: I don't know what misuse of science is. I mean, I think I know what science is. I guess you could say that killing people or terrorists using a modern scientific phenomenon to kill people would be a misuse of science. I don't know -- but, you know, science -- I am actually kind of old fashioned in my attitude about science. I really do think that while there are many societal implications of science and there are many issues, philosophical and ethical issues, associated with applications of science, at the core of it, science really is a method for continually making our ideas about how nature works or how things work around us less and less wrong. We have this method, and it's based on impurism, based on actually looking at what's out there systematically and it's the only way we know to arrive at progressively closer approximations to what may actually be in the world. That's a concept that to which the word "misuse" doesn't readily apply. So you have to look at peripheral issues associated with science. Are the people who are doing the science honestly reporting what they say, for example, so we have the issue of fraud in science, misrepresentation for one purpose or another. It may be that people misstate scientific conclusions to support a preconceived notion that would be wrong. So, perhaps deliberately misstating or misrepresenting, if you're in a position of authority, misrepresenting what science says to support a preconceived notion, that's probably a misuse.

DR. PIELKE: Where do you come down on the issue of potential Advisory Committee nominees being asked who they voted for?

DR. MARBURGER: Well, I think that it doesn't make sense to ask somebody who they voted for. We have secret ballots in this country, and I don't think that's a very good practice and I wouldn't advise it.

DR. PIELKE: So just last week, the Union of Concerned Scientists was at it again and they released another report with a group called PEER, Public Employees for Environmental Responsibility, and they released a survey of the Fish and Wildlife Service employees indicating, among a wide range of things, that 20% of respondents said that they had been "directed to inappropriately exclude or alter technical information." So, to be fair, the survey wasn't scientific, it had only a 30% response rate, but it lead the Union of Concerned Scientists to conclude that "political interference in scientific findings has a chilling effect on scientific candor and staff morale." So, presumably this came

to your attention last week and your office had some response. What was your reaction?

DR. MARBURGER: We didn't respond to it, but I certainly did look into it. I looked at the report, I looked at the survey and the survey results and how it was done, and I actually talked to senior officials in the Interior Department to find out what their take was on it, and I'm familiar with some of the issues that the Interior Department has had to deal with lately, the enforcement of the Endangered Species Act, for example. And after I looked at it, I concluded that this was not an indication that there was something seriously wrong in the Agency and that, rather, that this was a sort of an expected result for a survey of that type. We do have a new administration that has a broader interpretation of some of the laws that they are charged with enforcing. It's different from what was there before, and I would expect that there would be people who would be unhappy with how it was done. That doesn't mean that everybody is a good administrator or that everything is perfect there, but I felt that it was an issue that the Department of Interior should handle, it didn't look like something out of the ordinary that you would expect the Secretary of the Department of Interior to be able to deal with.

DR. PIELKE: So, I guess if your visit here to the University of Colorado is representative of your visits to other scientific organizations around the country, you probably spend a lot of time talking about the Union of Concerned Scientists' report and in answering questions, and I was wondering, what do you see the effect that these reports have had generally on discussion and debate within the scientific community between OSTP and scientists? Has it changed?

DR. MARBURGER: Well, you know, except for situations like this where we have a general audience and people are concerned about these things, in this kind of setting I do get a lot of questions about UCS, but I don't spend a lot of time on it. It's not something that -- it's peripheral to my job, it's peripheral to the operation of science despite the concern, I don't see evidence for a great undermining of American science, which is very strong. When I talk to individual scientists about their work, they seem to be doing it the way they've always done it. So I don't give a lot of mental space to this. I do take seriously concerns like this and complaints and try to understand them in their context, and if it looks like it's something I can do something about where there really is something wrong, then I try to fix it or do what I can from my position. But I don't give a lot of mental space to it, and, frankly, although it may be a topic of discussion, I don't think that it is seriously affecting science in the United States.

DR. PIELKE: Along these lines, during the election last year, there was a 527 Advocacy Group organized called "Scientists and Engineers for Change." It was widely characterized as being the greatest mobilization of scientists and engineers in the Presidential election since the 1960s. And I was wondering, what are your thoughts on scientists and engineers gathering together under the banner of being scientists and engineers and becoming active politically? Do you think scientists should identify themselves as scientists and get into the political prey, or should they spend their time joining existing advocacy groups and environmental causes, nuclear causes, and economic causes -- whatever their values happen to lie in?

DR. MARBURGER: Well, you know, there are two ways to look at it. In the first place, any group that has something in common is free in this country, and often does, join together in some association for and engaged in political advocacy. That's normal. It's not anomalous, it's not bad, it's good. It's the way we do

things here. So it's a normal phenomenon. On the other hand, and the other way of looking at it, is that to the extent that people use their common identifier as scientists to justify a non-scientific position, or a position that doesn't have too much to do with science, then that's -- I would question that. Before I would join such a group, I would want to know if, you know, are we saying that this is a position, the position we advocate is based on science or is that what we want people to believe? And so there is a little bit of a problem there, I think, and scientists have a responsibility to try to avoid misleading the public about the basis for their political or religious or ideological beliefs. I mean, that's separate from science. So we do have a responsibility, the scientific community, to try to separate the science from our beliefs or from non-scientific issues.

On the other hand, I see nothing abnormal of people who tend to read the same literature and see each other at the same parties and conferences and so forth, getting together to do political actions. So, you know, it's so many issues. There's no -- one has to decide for one's self whether you're doing the right thing in joining a group that has a point of view that's related to your profession.

DR. PIELKE: All right, this is the last subject. A few questions on the budget and then I'll take some of the audience questions.

Last week, the President released his proposed FY 2006 budget. The AAAS characterized it as follows: "It is striking how much the budget retreats from federal investments in science and technology and important areas." You showed some numbers with some large run-ups in funding in recent years. During the first term of the Bush Administration, funding for research and development increased by 44%. I won't go through the other numbers, but as a percentage of outlays, it was the highest total in 37 years. So, in this context, what is your reaction to members of the scientific community and scientific organizations who criticized the level of investment in science and technology at that aggregate level?

DR. MARBURGER: I've been in science and higher education and administration for a long time, and I don't think I have ever experienced a year when there wasn't complaining about the budget by one or another -- actually, large portions of the science community, when it came out. So, there is some journalists who have made a career of commenting on that phenomenon. What's happening here, first of all, is that there are lots -- there's a big appetite for science. We have extraordinary opportunities today. There is a huge frontier of science that has been open to us during the last decade by the technologies that are now available, as in information technology alone, but also the ability to manipulate atoms one at a time on a small scale.

We have a whole new world of complexity, of quantum coherents phenomenon, for example, biotechnology, microbiology, nanotechnology, and we also have new opportunities in astronomy and astrophysics, and particle physics and many other areas as well. And, in many cases, the new technologies have made it possible for us to do things that we never could imagine doing before -- ten years ago. So, there is an enormous appetite for science, and I think to put the very fairest light on the reaction of the scientific community, there is a sense -- there is always a frustration.

Certainly now, as well as in the past, that the opportunities are much greater than the assets that we have or the means that we have to address them. So that's always there.

There is another phenomenon, which is that this complexity of the budget process that Dan Sarewitz pointed out in his 2003 essay that I read from, does make it hard to get the money into the right places, even when everybody agrees on what the priorities should be. It's not always easy to get the money there because there is competition. For example, the National Science Foundation, I see the head of the National Science Board here in the audience, is very aware that the National Science Foundation has to compete with Veteran's benefits and NASA and so forth, and the Department of Energy, Office of Science, has to compete with water projects, Army Corps of Engineers' projects. So, whereas the competition for NIH is somewhat different and probably a little bit less in their appropriations process. So there's sort of -- it's easier to get money in some places than in some others, and there may be some frustrations expressed there too.

But in general, I think that we would have to acknowledge that our power as scientists has increased dramatically in this information revolution and this instrumentation revolution. We can do a lot more than we used to be able to do, despite the flat budgets in some of the physical science areas. We are still enormously productive in physical science. We're doing amazing things. And I do believe that this period during which the President is trying to close the budget gap and to chew away at the deficit is a period where we can afford to have these relatively flat budgets and we will not lose our competitive advantage to other countries.

I think we have the ability to do things, and within the envelope of the existing budget, which is three times Japan's budget for science, which is the federal budget, which is the next largest one, and one and a half times greater than all of the investments in the European communities. Within the context of this budget, we can make choices and we can establish priorities and we can find out which things are more important to do than other things. And I don't know that it's necessary for us to do everything that we can do right away. We can wait for some of the things that are now possible for us to do. To that, I'd like to see some things done in my lifetime that I have always been curious about, but on the other hand, it's not clear that they are going to have Earth-shaking importance for society. So, I think we ought to try to find out which things we should be doing now to sustain our economic competitiveness and also to make advances in the most exciting areas of science and put off some of the things that we don't have to do right now that are still exciting and plan to do them in the future and sustain.

You know, the fact that the fraction of our discretionary budget that we spend on science every year is practically constant year after year. We may not feel it this way, but it actually gives us an opportunity to plan. We can count on that.

One more thing about this, and that is that aspirations for economic development in regions that are formerly underdeveloped in the U.S. from a technological point of view, have generated a large infrastructure. Lots of states have invested in research buildings for biotechnology, for example, or nanotechnology around the country. There have been rather substantial build-ups of science infrastructure throughout the country. I don't have data on this, but it is something that's worth looking at and I think it's creating an appetite for science that's growing pretty rapidly and may create frustrations when we can't satisfy it immediately. So those are some observations about it.

DR. PIELKE: On to audience questions now. I had two voice mails on my phone this morning from people I didn't know and a couple of emails from students, and I promised this would be my first question. Tell us about Hubble and the decision process on Hubble?

DR. MARBURGER: I think -- how many people in this crowd have some direct involvement with Hubble? It must be -- I know there are quite a few here in Boulder and you should be proud of the accomplishments.

I like to listen to the science community about Hubble. I agree that Hubble is an important instrument. It is nearing the end of its life anyway. It has become a kind of a mini-space station because it's value in the future does depend to some extent on what additional instruments you can screw on to it and it, of course, that makes it a very expensive instrument to maintain. I mean, it was -- it's the only big telescope we have up there in space that's designed to be serviced by the shuttle and the shuttle is an extremely expensive way to go about doing this.

So, I think there is a money question here, and I think that the way NASA has positioned this, it's a question of whether the scientific community feels that it's worth it to spend the actual dollars that are necessary to do it.

Now we get into a fuzzy area of who pays, and is it just marginal costs or is it the full cost? But, I think that it is important to hear the scientific community on this issue, and I heard -- if I'm not mistaken, I heard Joe Taylor say at the House Science Committee hearing on this last week that if the science budget had to pay the full freight, it shouldn't. It shouldn't be serviced. We should spend the money on other science missions. On the other hand, if somebody else was willing to pay part of the cost, then we should go ahead and do it.

It kind of makes it hard on me. It sounds like from the point of view of OMB or somebody who is responsible for all of science, all of that money comes roughly from the same pot and I would say that the decision not to put the Hubble mission money in the `06 budget was probably consistent with what I'm hearing from that testimony.

You know, space-based telescopes are really important and I think there is a commitment to the big telescopes. I wish that we had designed Hubble so that it didn't have to be serviced by a shuttle. We probably could have launched several Hubbles for the cost that we have invested in this one.

DR. PIELKE: All right, so I'm going to go through these questions and I'd like to see how many of these we can get through. I'll just read from the card. "How do you see the role of the public in science policy decision making?"

DR. MARBURGER: Well, the public -- first of all, the public elects public officials and you don't see a lot of science in public campaigns. Maybe the public who cares about science can write more to their elected officials, their Congressmen and other officials, and tell them that they think that science ought to be a bigger part of their jobs and a bigger part of their campaigns and let's find out where they stand. I think the general public can have a much greater impact on the issues that become salient in political campaigns than they realize.

We are not just responders to clever campaign literature or TV ads. We do have the ability to act independently on the issues that we think are important, and

I think the most important thing the public can do is what the public is expected to do, which is to vote and to communicate with your Congressmen about how you vote and what your important issues are and be serious about it.

DR. PIELKE: Let me go out on a limb here and suggest that maybe the intent of the question is to suggest maybe focus more on whether the public should be involved in setting research priorities. So, for example, nanotechnology or human gene research, we want to involve representatives of the public, what they do in Denmark and other places in not just advocating for science funding or to the electoral process, but in actual nuts and bolts of decisions that heretofore have been just the province of science.

DR. MARBURGER: Well, you're sacking it too much. I mean, you don't want the public to be involved in telling scientists how to do their work. And, in general, I don't want the public to be telling us about discovery science and basic science and topics in basic research -- only the science community can say that. But the more applied the science is, and the more it relates to things like public health or environment or even military or Homeland Security, then I think that the public has more of a responsibility in defining its expectations. So there's clearly a gradation of types of science that the public should be involved in.

DR. PIELKE: All right, this is a work force question. "Science currently draws on a very small subset of the population, primarily middle-class white males for its work force, likely passing over a great number of possible geniuses. This is despite considerable efforts to persuade the establishment to be more diverse. Is it appropriate to include diversity in science budget policy, i.e., Title 9 for science?"

DR. MARBURGER: I think that it is appropriate for agencies that fund science, especially in educational institutions, to have diversity objectives. I think it is important to have materials that attempt to make science more attractive to currently under-represented groups. It's a perfectly legitimate use of funds and, in fact, it has been an objective of the National Science Foundation for a long time and I think we should be proud of that.

So, yes, I think we should be concerned about the lack of diversity, and it's not just gender diversity, but it's also a sort of socio-economic diversity, and there is many good reasons for trying to -- you know, it's not only to offer scholarships and things like that, but also to try to re-think how we present our introductory courses, for example. You know, we don't do a great job of teaching freshman physics and freshman chemistry and freshman biology so that people who might be a little un -- lack confidence in their preparation or something are deterred from continuing in science as a career.

I know a lot of young people come to college aspiring to be scientists or engineers, and they are turned off after their first year or two and they go into another field. And I think if we could just tap into the stream of people that already want to do it and provide opportunities for them and appropriate types of instruction, then I think we could make progress faster.

DR. PIELKE: "If, as you know, there is no explicit job description for your role, do you see it more as (1) defining the importance of science to the administration, or (2) selling administration policy to science?"

DR. MARBURGER: Neither of the above. Science is already deeply embedded in federal operations, in governmental operations. Every agency has -- almost

every agency has a chief scientist. I mean, there are far more scientists and science operations in the Agencies today than there were in the `40s, `50s, and `60s when the Science Advisory apparatus was being constructed.

So, I think that there is a lot more -- now, that's not necessarily true at the very top of the policy making levels in government, but it is certainly true at the areas where the science input is most appropriate. So, that makes my job easier. I am confident that there are people in the National Science Foundation and NASA and the Department of Energy and the Department of Interior that know science and are trained and excellent, and part of my job is to make sure that those political appointees and the Secretary or Under Secretary are taking their own scientists seriously and using the science that they have available to them in appropriate ways in their regulatory processes and decision-making.

So part of my responsibility is to make sure that the apparatus that exists is functioning, and I try to do that by meeting with the scientists, chief scientists and so forth. I am not a blind advocate for all of science. I mean, I think that we have to make choices in society. I love science. I think I could safely say I love all science, but at the same time, I have to admit that some science is more important for our nation at times than other science is, and we should be making -- this is why I like Alvin Weinberg's essay. Weinberg said "it wasn't so much about big science." The big science part of Weinberg's ideas are not as important as the fact that he has tried to inject this notion that some things are more important than others. One of my predecessors -- are you having Frank Press here in this series?

DR. PIELKE: No.

DR. MARBURGER: He's not. Well, too bad, because Frank Press, almost unique among my predecessors, tried to get this idea of priorities out there and he tried to get the science community itself to establish the priorities. I'm not sure -- well, that's what we have to do. So, I try to make science work for the nation. That's my idea, and I do advocate for those areas of science that I think are -- that based on my judgment coming from the science community that are important to do.

DR. PIELKE: This next question has one word at the top, and would probably be enough to get a response, but I'll read the question. The one word is "evolution," and it says "Why doesn't the White House play a more active role in articulating evolution as good science?"

DR. MARBURGER: Can you really see any White House doing that? Evolution is the cornerstone of modern biology. Period. What else can you say?

DR. PIELKE: All right. "Representative Vern Ehlers, Republican of Michigan, Chairman of the House Science Sub-Committee on Environment, Technology, and Standards, has stated that he believes there is nothing wrong with mixing science and politics in determining the make-up of scientific advisory committees. Indeed, he is quoted as saying that he believes it is appropriate to ask potential panel members who they voted for in the last election as part of the nomination process. What is your opinion regarding the separation of science and politics when writing policy?"

DR. MARBURGER: Well, I think we've already talked about that a little bit. You know, Vern Ehlers is a politician and I'm a scientist and I just -- he can say

whatever he wants. I personally don't think it's appropriate to ask somebody who they voted for.

DR. PIELKE: Winding down here. This was a question that came up numerous times today, so it's worth asking it again here. "How can we justify shifting NASA money from Earth science, for example, or Earth observation satellites, to Moon-Mars exploration at a time when the Earth faces multiple crises, climate change, de-forestation, oceanic pollution, etc.?"

DR. MARBURGER: Well, I believe that Earth is the most interesting thing in the Solar System for a lot of reasons, and I don't think that we should, in any way, abandon or diminish the importance or significance of our studies. I think NASA has a responsibility for Earth science. It has unique capabilities for studying the Earth from the position of space, and I'm not aware of any policy that seeks to undermine that capability in the long-run.

I am aware that NASA is under severe budgetary constraints, a lot of demands, and has to work out its internal priorities, but in general I don't see that Earth science is being abandoned by NASA and I don't think should be.

DR. PIELKE: All right, the last question for the evening. "When you're working on your book after your time as Science Advisor is over, what's the title of your book going to be?"

DR. MARBURGER: I am working on a book. The title of the book is "Beneath Reality," and it's about quantum mechanics and it's about the standard model. And it's written for people who are serious about wanting to learn something about modern physics but don't have -- and are sophisticated, but don't have a technical or math background. So that will probably be my first book and I hope to write other physics books after that.

DR. PIELKE: All right, well why don't you join me in thanking Dr. Marburger for coming out here tonight?
(applause)

STATE OF COLORADO)

) ss. CERTIFICATE

COUNTY OF ARAPAHOE)

I, Christopher Boone, Notary Public within and for the State of Colorado, do hereby certify:

That the foregoing proceedings were transcribed from a digital recording and thereafter reduced to typewritten form under my supervision, and that the same is, to the best of my ability, a true and correct transcription of the proceedings as I was able to hear them on the digital recording made available to me for re-recording transcription;

That I am not related to or in any way associated with any of the parties to said cause of action, or their counsel, and that I am not interested in the event thereof.

In witness whereof, I have affixed my signature and seal this 10th day of March, 2005.

My commission expires August 16, 2006.

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Christopher Boone, Digital Reporter