"POLICY, POLITICS, AND SCIENCE IN THE WHITE HOUSE: CONVERSATIONS WITH PRESIDENTIAL SCIENCE ADVISORS"

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GEORGE "JAY" KEYWORTH, II
PRESIDENTIAL SCIENCE ADVISOR TO RONALD REAGAN

DR. GLEASON: Good evening, I'd like to welcome you all this evening to tonight's presentation. My name is Todd Gleason, I'm the Dean of the College of Arts and Sciences.

And as part of a number of sponsors of tonight's series, it is my pleasure to introduce all of you tonight to this program titled, "Policy, Politics and Science in the White House: Conversations with Presidential Science Advisors."

We're very lucky tonight to have Dr. George Keyworth with us; thank you very much, George, for joining our campus.

This is a program that has been sponsored by the Center for Science and Technology Policy Research. The Center operates out of CIRES, and is focused on topics of science, policy and societal need on developing policy alternatives for public policy makers, and for developing decision tools which they can use in reaching sound policy.

Programs like this inform not only the Center, but those of us in the more general public as to the interface between politics and science.

This program has been sponsored by a number of organizations. Those organizations on campus include CIRES, the graduate school, the Office of the Provost, the College of Engineering and Applied Science, and of course, the College of Arts and Sciences.

Your host tonight is Roger Pielke, Jr. Roger is the director of the Center, and will interview Dr. Keyworth this evening.

Roger earned his doctorate in 1994 in political science from the University of Colorado, and worked for seven or eight years at NCAR as a staff scientist before joining our faculty in the Department of Environmental Studies and in CIRES in 2001.

He is a Fellow of CIRES. His dissertation was on topics related to global change policy, but he has written widely, co-authored and co-edited three books, and a boatload of articles on a variety of topics related to atmospheric science and policy, weather policy and decision-making, and more recently, some of the policies related to hurricane damage and restoration associated with hurricanes.

It's a pleasure for me to introduce Roger and, again, welcome you all this evening. Roger?

DR. PIELKE: All right, welcome! And to many of you, welcome back! We missed you over the break. This is the seventh event in our year-long series Policy, Politics and Science in the White House.

And, again, I'd like to also welcome George "Jay" Keyworth to the University of Colorado.

In addition to the institutions that Todd mentioned, I'd also like to thank the Southwest Research Institute here in Boulder, the Colorado School of Mines in Golden, and Boulder-based ICAT Managers for their contributions to making this series occur.

Any event like this requires a lot of hard work and dedication from a number of individuals, and I'd like to thank two people in particular: Bobbie Klein, who is the managing director of the Center for Science and Technology Policy Research, and Amy Nacu- Schmidt, who is our Outreach Coordinator. And a few other folks I haven't mentioned have been very instrumental in making this event happen.

I'm sad to say this is the second-to-last event in our series. The good news is that this was going to be the last event, but we have heard from Frank Press, who was the science advisor to Jimmy Carter, who declined our initial invitation for health reasons, and feels strong enough to come visit us and is very excited to do so. And he's going to be here on April 11th. And he tells us in his correspondence that he's coming here to "name names." So, I'm not sure what that means, but I hope it's a sufficient draw to bring you back in April.

We have a content-rich website, and I hope that you'll have a chance to take a look at it. It has all of the videos from the previous science advisors visits, transcripts, background reading, and plenty of information if you're interested in policy and politics.

And now let's turn to the main event tonight. As usual, we're going to have three parts to our series. First, Dr. Keyworth will give some prepared remarks. After that, we'll proceed with a short question and answer interview, where I'll interview him here on stage, and after that, we'll open the floor to your questions for Dr. Keyworth.

So let me now introduce Dr. Keyworth. I could read for the entire time that we have here, but I'll give some high points.

Dr. Keyworth is Chairman of the Progress and Freedom Foundation. Simultaneously, he remains chairman of the Keyworth Company, a firm established in 1986 to work with companies in developing strategies for growth based on emerging and changing technologies.

From May 1981 to January 1986, Dr. Keyworth was Science Advisor to President Reagan and Director of the White House Office of Science and Technology Policy.

As the senior technical member of the President's staff, he led the administration's efforts to capitalize on U.S. science and technology to strengthen industrial competitiveness and was instrumental in establishing strong budgetary priorities for university basic research,

and strengthening university engineering programs and in stimulating more productive industrial participation in university research and education.

Prior to his White House service, Dr. Keyworth was Director of the Physics Division at Los Alamos National Lab, which he joined in 1968.

As a research scientist, Dr. Keyworth's contributions include pioneering work in high-resolution spectroscopy. He has had many -- a great deal of experience with international science and technology policy, including working closely with France, Germany, Israel, India, and the People's Republic of China.

Dr. Keyworth received his bachelor's degree in physics from Yale University in 1963. He was awarded a Ph.D. in nuclear physics in 1968 from Duke University, where he conducted pioneering research in isospin conservation in nuclear reactions.

Why don't you join me in welcoming Dr. Keyworth to Boulder.

DR. KEYWORTH: Thank you very much, and thank you all very much for coming out tonight.

It is always a real pleasure for me to visit Boulder. Some might even think I live here, that I might even be on the UC-Boulder faculty, retrained or recycled as a Sinologist. In truth, it's just that my son and I share the same name. So, Boulder is a special place for me. But it's also special because of the tremendous progress that the University has made in recent years in moving to the forefront of academic scientific research, with UC-Boulder scientists earning three Nobel prizes in just the last five years.

I also commend you for attempting to provide a rational basis for understanding science policy, a goal that I hope will not prove too elusive.

Studying how White House science advice, and OSTP, the Office of Science and Technology Policy, work is a good window into how science policy is made.

Now, since several other science advisors have already spoken in this series of talks, I will refrain from giving you the history of the office. Nor will I spend much time addressing presidential science advising in general. Instead, I'll just try to share with you some of my own experiences and observations from what was for me a fascinating five years, and for the whole world a particular time of monumental change.

It was that brief period where US-Soviet tensions first heightened, then waned, with the Cold War quickly, and unpredictably, ending.

Now, let me first insert a little perspective. OSTP remains somewhat of an anomaly among Executive Offices of the President, viewed by some White House staffers as an asset, but by some others as an imposition. How a consensus among those diverging views emerges, assuming that it ever does, has much to do with how the office functions. And circumstances differ. Each of us has advised different presidents, at different times. Priorities varied, pressures were different, and personalities created different relationships.

In my comments tonight, I'm going to dwell somewhat on the key relationships that developed during my tenure, because they were key to my ability to be effective.

I joined the Reagan Administration in early May, four months after the President's inauguration and after the assassination attempt. During the first few months, as well as during the transition planning, there had been much debate over whether a science advisor was, in fact, needed. Opposition stemmed largely from the perception that OSTP in its then-form had been re-created by the Congress to represent its, and the scientific community's, interests in science and technology, while the White House staff was there strictly to serve the President.

In other words, a number of the President's closest and trusted friends and advisors viewed a science advisor as somehow likely to be different from them, and likely to come with an agenda that might differ from the President's.

The countervailing view, which eventually prevailed, was simply that since so many of the Administration's top priorities - for example, defense, energy and the changing economy - were deeply rooted in science and technology, that they needed a team member with competency in science. Without expertise on the President's policy team, the White House would be dependent upon the external agencies, and they would be even less certain to share the President's priorities.

So by the time I was invited to Washington as a candidate for science advisor, the debate was over, it was resolved, and I sensed a real spirit of welcome.

Now, in its first term, the process of policy development in the Reagan Administration was conducted in a somewhat more centrally organized manner than in some administrations.

Edwin Meese, who bore the title of Counselor to the President, coordinated all policy making, whether domestic, defense or even foreign policy. This wide-ranging power, along with Ed's real talent for the job and his uniquely close relationship with the President, led to him often being referred to in the press as the "Deputy President."

Now, one of the means Ed used to coordinate policy development was to hold meetings each evening in his office, with leaders of each White House office involved in policy matters, including OMB, about six of us, to discuss both thetactical issues of the day as well as the longer-lasting, more strategic areas.

As a member, Ed Meese made it possible for me, early on, to develop a relationship with the President, as I will explain, and with the other members of the President's senior staff.

Now, let me make an important point: A President, in fact, has many, many assistants, but few bona fide advisors. And only he can make the distinction. You're hired as an assistant. Whether you ever become an advisor depends on the value you can provide. The opportunities may not be what you expect.

In the summer of 1981, one of the Reagan children began to appear frequently in the press in apparent sympathy with a number of anti-nuclear activists. Worried about her being exploited, the President turned to Ed Meese for advice. Ed suggested I might help.

The President then called me to ask if I would mind coming over to talk about a personal matter. Sensing that his daughter would probably not react well to his own counsel, the President asked if I would go out to California and talk with her. I did, and that became the first step in my personal relationship with the President.

Just a few weeks later, the President again called unexpectedly, also at Ed Meese's suggestion. I remember it as being on a Saturday morning, and the President asked if I'd mind coming over to discuss an issue that he was pondering. He put the question quite simply. He said, a lot of good people, well-intended people, were suggesting to him that we commit at least a hundred billion dollars or so to this new technology called "Stealth," and he needed to know some basics before making that commitment. In particular, he asked, "Does it really work, and if so, will it continue to do so?"

This was a turning point for me in two different ways. One is that as I started to give a quick answer, it suddenly occurred to me that this was not the kind of scientific exchange I was used to engaging in with my colleagues at Los Alamos. Here, there would be no opportunity to revise my best guess.

Catching myself, I deferred in answering until I could gain enough knowledge - real knowledge - to be confident in my advice. As it turned out, it took several months.

The second reason this was a turning point was this was the first time I confronted the unusual nature of advice to the President, and the extraordinary isolation that the President has in so many of the key decisions he must take. And I saw that vulnerability time and time again.

As a result of that simple question as to the viability of Stealth, and the challenge that responding to it entailed, we were able to develop within OSTP some substantial expertise in some of the more arcane, and most sensitively classified areas of defense technology.

In Stealth, anti-submarine warfare, space- based surveillance and other key technologies that underlay our defense modernization efforts, we became "credentialed" and OSTP became a full member of the President's team.

We were assigned a role both in advising on defense issues, and in articulating the basis for those decisions on defense.

In those years of the early 80s, clearly the Administration's top priority was defense. As a result of the role OSTP played, I became a regular attendee of the National Security Planning Group, which is the pared down version of the Cabinet that dealt with issues of national security.

Now, let me stray here to comment on that initial concern that the Science Advisor might have an agenda separate from the President's. Many of my colleagues may not have had agendas of their own. I confess that I truly did. It was a strong belief stemming from my own observation that no federal research dollars, on average, gain more fruitful rewards than do those relatively few committed to basic research, the search for pure knowledge.

In contrast, federal R&D ostensibly directed toward aiding the economy generally failed.

We had quite a few opportunities to weigh in on policy issues having to do with industrial competitiveness, such as the rise then of Japanese microelectronics. Fortunately, we generally wound up advising no action, which turned out to be the best policy.

But I was committed to making basic research a major priority in our Administration's support of R&D. Now, while that may not have been, initially, much of an Administration priority, it was absolutely consistent with the President's views of the proper role of government. And, to an extent, simply as a member of the President's personal team, I could always put forth the cause for basic research. And I did.

But, to be truly effective in terms of major funding, it takes a lot more than simple persuasion. There are simply too many competing needs. Instead, one has to earn what I'll simply refer to as "points," the means to barter effectively for competing priorities.

Just as in many other walks of life, one earns points by producing value. Let me share with you one example.

In the fall of 1982, the Administration was having a difficult time indeed finding a politically acceptable basing mode for the land-based MX missile. As the final link in the Administration's program to modernize nuclear forces, and central to returning to more fruitful arms reduction negotiations with the Soviet Union, a lot hinged on solving this one problem.

Many options were reviewed, a process in which OSTP played a prominent role. Finally, agreement began to emerge on a somewhat arcane concept, called "Densepack." However, controversy arose over just who would articulate the technically complex rationale behind the decision.

In an effort to resolve an impasse between the National Security Council, NSC, and the Pentagon, OSTP was asked to take on the task.

It took months of effort by a good portion of our staff, and turned out to be a particularly difficult task. In the end, we failed to win Congressional support, but we did succeed in at least raising awareness of the importance the President put on completing the MX program, and that did pay off later.

But the battering that OSTP took on this effort, and the evidence that we could hold our own on a nasty public and Congressional battlefield, earned us some additional legitimacy. We had acquired some "points."

Few people who come to Washington for the first time really understand what they're getting into. This is especially applicable to science advisors, who come from a wholly different world. So, you either learn, and quickly, or you become irrelevant.

Fortunately, earlier in my tenure in Washington, an acquaintance had suggested that I study the wisdom to be found in Machiavelli's writings, especially in The Prince, perhaps the greatest treatise ever written on the exploitation of power.

Unlike business, Washington is far more about power than it is about process. Where we in OSTP most needed power was in the budget process. While the Administration had certainly agreed that funding for basic scientific research, particularly in universities, deserved the special protection first defined by Vannevar Bush after World War II as a "federal trust," there was, of course, a wide range of opinion as to just what funding increases were actually needed.

The 70s had been a generally tough decade for basic research, especially with huge rates of inflation of the previous few years, and we in OSTP felt that some pretty heroic funding increases were required.

This is where we chose to spend our points. We spent them on the subsequent 18% annual increases in NSF's budget; on the introduction of a number of major new programs, such as the NSF Centers and Young Investigator Awards; on new facilities that had never appeared in Agency's budgets.

Those and other increases were the result of negotiations where such "points" were required. While each of these thrusts were consistent with Administration policy, the individual initiatives could only be obtained because OMB knew that we were willing to let Ed Meese, or the President, resolve differences of how to implement those policies.

Finally, let me come to the single issue that most shaped OSTP in the Reagan years. It is the one issue for which OSTP during that time was best known, it was controversial and divisive beyond imagination, and it certainly had the most impact on the world.

From my earliest meetings with the President, and with him, of course, knowing about my background at Los Alamos, he often spoke to me about his concern over the basic premises upon which nuclear deterrence was founded. Like Presidents before him, he was saddled with a defense strategy that relied on the threat of genocidal retaliation to prevent nuclear attack.

From the start, he detested the concept of mutual assured destruction, and unlike his predecessors, and most of the defense community, he had little, and lessening, confidence that it served either the nation's or the world's long-term interests.

He also observed that, in spite of various arms control treaties and agreements, the nuclear arms race continued unabated.

Still more distressing to the President was his observation that even the fundamental assumption about the validity of nuclear deterrence, that is, its presumed stability, was eroding. In nuclear deterrence, stability is the all-important condition that defines the likelihood of one side deciding to risk a pre-emptive strike that would be capable of reducing the chance of significant retaliation.

With stable deterrence, there's simply no incentive for anyone to initiate an attack. This was the case for decades, where population centers were targeted.

However, with two particular technological advances of the mid-70s, more precise targeting of warheads, and the ability to mount multiple warheads on single missiles, it became feasible to make the other sides' weapons, such as missiles in silos, the targets.

While still unlikely, preemption was beginning to be conceivable. One could see the trend lines, and the result was that stability was going to continue to erode over time. The situation would just get more dangerous.

During his first two years, modernizing the nation's strategic forces and rebuilding the military was the President's top priority. He was immersed in every aspect of it.

In weighing the various options for modernizing our strategic forces, in moving arms control from the SALT framework -- Strategic Arms Limitations -- to START -- Strategic Arms Reductions, and simply in trying to understand the Soviet Union's motives and intentions, President Reagan grappled with all the intricacies of deterrence.

As a consequence, when the opportunity presented itself in early 1983 in the form of new technologies, he decided to take the bold step of SDI, or the Strategic Defense Initiative. Expressed most simply, he concluded that the stability of deterrence was eroding, that it was wrong, and that there had to be a better way, in the long term, to ensure our national security.

And he was taking the long view, not proposing a development project, but proposing a research program that would lead to such development. In this sense, he was a Science Advisor's best and most demanding client. He believed, based on evidence of some remarkable new technologies, that US efforts in science and technology could develop better, more humane, and more lasting responses to nuclear threats than currently existed.

He challenged the science and technology community to make it happen, and he never wavered for a second in that determination.

Well, what was OSTP's and my role in all of this? This is one of those areas where most people on the outside had little idea of what really occurred. So let me correct just two of the many myths that unfortunately masqueraded accepted knowledge.

First, the idea of SDI had roots that went back many years in the President's mind, and he had bided his time through his first two years as President until he could find the right time to bring it to fruition. I know that, because we talked about deterrence on many occasions.

Few people on the outside knew it because they only saw the visible first stage of his defense planning, which I characterized earlier as the strategic modernization program, which focused on traditional weapons systems.

So SDI was his idea; it was his idea waiting to emerge.

Second, there was substantial technical assessment of SDI's long-term feasibility well prior to the announcement. When I was consulted by him, I already had the benefit of some recent studies - classified studies - by my own advisory group, the White House Science Council, that showed a dramatic change in potential defensive technologies.

I was asked by the President for a go/no-go opinion on SDI's feasibility, which I can assure you was the most momentous and frightening decision ever thrust upon me.

But my role was as an advisor, and to tell him what was possible.

The President wrote virtually the entire announcement of SDI himself. I advised him, I helped edit the speech, and offered him choices for restating key points. I did my best to explain the President's intent to other members of his staff or his Cabinet.

George Schultz, in his book Turmoil and Triumph, argues that the President relied too heavily on my advice. For technology assessments, he did rely heavily on me, but that was my job. But I had little initial input into shaping the larger policy, and my input was not needed.

One need only examine how Ronald Reagan carried out his negotiations, personally, with Mikhael Gorbachev, to see just how independent and determined he could be. The President had, from the beginning, a clear vision of where he was leading the country, and SDI was just part of how to get there.

He and he alone made the estimates of the risks and benefit, and he never wavered. From the point at which SDI was announced, March 23, 1983, I became a single-issue Science Advisor. Those were my orders.

Fortunately we had already set in motion the restoration of support for basic research, and the OSTP staff did a pretty good job of maintaining that pressure in the years following.

But the President asked me to represent his interests and intentions on SDI, so that was my priority. I did that as a very visible spokesman inside and outside the White House, and I coordinated the beginning and re-orientation of research efforts until a formal program could be established in the Pentagon.

In particular, while the diplomats were trying to position SDI as just another pawn to be traded away in the game for some modest gains in arms control, I was traveling the world, visiting heads of key allied states, carrying the President's message that SDI was under no circumstances open for negotiation.

I knew his commitment, I suppose better than anyone else, and spoke with confidence that everyone else thought was misplaced.

It was not until the end of 1986, at Reykjavik, that the rest of the world recognized the depth of his commitment to SDI. He turned down a remarkable offer of arms reductions from the Soviets because the price of it was killing SDI.

The world, or at least most of it, was aghast and accused him of a massive blunder. They were wrong, and, in fact, it was at Reykjavik that the Berlin Wall began to fall.

While I wouldn't for a moment claim that these times I've described are akin to those that I experienced a generation ago, neither are they anywhere near as different as I suspect many believe.

The end of the Cold War has not seen as much diminution in defense spending as some had expected, and it has brought into focus new and demanding technological challenges in national security.

Arguments that basic research is no longer necessary are to me as unjustified as was the suggestion, more than a century ago, to abolish the patent office, since most ideas had already been invented.

Now, with that as an introduction, I look forward to the best part -- a good discussion.

(applause)

DR. PIELKE: All right, well, a few questions for you. We have questions that we've collected based on looking at some of the histories that have been written, and also collected some from our students. And so we'll go through a number of these and then we're going to turn it over to the audience for questions. Can you tell us how you became science advisor? You were science advisor at a relatively young age compared to some of the folks that we've talked to. What was the career path that got you into the White House?

DR. KEYWORTH: Well, I'm not sure it was a career path. I went to Los Alamos right out of graduate school, simply because I wanted to do a very, very expensive fundamental experiment in nuclear physics, and Los Alamos was the only place that could pay for it.

And so I went there; I did that for several years, and having spent so much money, I was called upon to pay the price of doing some administration, which I did for a while.

Ultimately, I ran all experimental science at Los Alamos, including fusion research and the weapons testing program and so on. But, I think I was really -- to answer your question, President Reagan was a youth chauvinist, and he had a series of lists that had been given to him by the National Academy and various groups that had advised him.

And his comment to me was that I was the only one on all the lists that was really young. I was 41 at the time, and science advisors are typically at the end of their career, so I think it has to do with the fact that Reagan was a youth chauvinist.

DR. PIELKE: In his book, Bruce L.R. Smith, "The Advisors," says that you "gained influence with the Reagan Administration because of its faith in science." Number one is, do you agree with this, and can you tell us a little bit about President Reagan's attitude toward science more generally?

DR. KEYWORTH: I think it's pretty well known that Reagan was a very optimistic person, and he believed that if you identify a problem, you can solve it. And he believed, as most of us do, I suspect, here in this room, that those tools are science and technology.

So, Reagan did not have a great fascination with science itself. I was saying to somebody today, I think the most beautiful problem in science is the spinning top, and the most beautiful subject in science is classical mechanics. I do think I would have a very difficult time explaining that to the President.

But, on the other hand, his faith that we could solve anything through science and technology was sort of eternal.

DR. PIELKE: We had some comments today when we spoke in one of the classes that you visited, about how policy makers understand science and how they understand technology and how that might differ from academic understandings of science and technology.

DR. KEYWORTH: I think you've got to sort of go back and think how, when you're in graduate school, you go home and explain to your parents what you're doing. You go very much back to basics.

I think it's a mistake to think that policy makers or elected officials understand things like, for example, the mere concept of basic research. I watched somebody who had been a pretty prominent member of the House Science Committee for years come to Los Alamos once and define "fusion research" as "basic research."

I hear people saying that NIH is basic research. These are not basic research by any stretch of the imagination.

So I think when you talk to policy makers in Washington, I think you've got to go back to the fundamentals. You know, it's a little bit like trying to teach -- it's a little bit like trying to teach a good physics class without calculus. You know, the trouble is, you really have to know it because you can't hide behind anything. It's kind of the same thing.

DR. PIELKE: Also in Bruce Smith's book, he commented that, "You never really had the sufficient resources you needed to build a strong staff. You had to rely on officials, borrow from other agencies, and your staff had a lot of turnover." Again, was this, in fact, an accurate reading of the history?

DR. KEYWORTH: I wish I knew this fellow, but this is a very interesting one, because I confess to having made a mistake that lots of science advisors have made.

I said in my prepared comments that most of us did not exactly have training. I did not go to your science policy courses, and I did not even -- honestly, I did not even quite know what the word "science policy" meant when I was a science advisor.

So, I was -- I did what I knew how to do. I knew -- I'm embarrassed to admit this -- I did not know anybody at the time who wasn't a physicist. In Los Alamos, we had a very interesting class structure. As my son will remember, we were on a hill, and all of the original housing allocations had been made by the government during the war. At the top

of the hill lived the physicists. In the middle of the hill lived the chemists. On the bottom of the hill lived the engineers.

I looked at this, and I said, "This is so distorted and so parochial," that we moved out. Basically, I didn't want to raise my kids in that kind of environment.

But my point is this: I thought the only kind of staff I would have in Washington were first class scientists. And, you know, that's not the way Washington works. And first class scientists are first class scientists, but they're not first class operatives in Washington.

So I very quickly learned that I needed staff. I needed people who could support me. The President didn't want to talk to anybody else in my office, and I had, at some points, a pretty large office.

I found that the only place on Earth where they train people how to be staff is in the military. And there are a lot of Ph.D.s in the military, thanks to Lew Allen's Air Force programs 25 years ago. And I found that I took a lot of people who were colonels and one stars. In my office, they were really good staff people, and that's how you get them. I think a lot of people had to learn the same thing.

And by the way, they weren't just good in defense areas; a lot of them were very good in science and dealing with NSF, and so on. And so, and I borrowed a lot of these people, because military officers couldn't come to work for me. It's the only way they could.

I never had budget problems. I had budget battles, but I never had any budget

DR. PIELKE: When Ed David, science advisor to Richard Nixon, visited, he told us about how President Nixon got rid of the position and subsequent to that, Congress acted -- wanted to put in the Office of Science and Technology Policy. Could you talk a little bit about how you perceive that the position changed during that process from being an advisor to the President to a Congressionally-mandated office?

DR. KEYWORTH: In my case, I really -- I don't think any one science advisor can tell you a lot about other science advisors. Ed David was on my advisory council, so he knows more about me than I know about him. He's a good man by the way.

But, there's no question that the original science advisor did not have to report to the Congress on the state of science or the state of basic research or anything else. And I have testified hundreds of time on everything from top soil erosion to, you know, the health of universities and every subject on Earth. I never had any idea I knew so much, but anyway, you wind up having to do this.

But nevertheless, the current director of the office, if he is named the science advisor by the President, which everyone since Frank Press has been, I believe anyway, you have the same legal protection in never having to share with the Congress what advice you've given to the President.

So you're dual-functioned, essentially. I confess, and when I said it in my prepared comments, that the second half -- actually, the three years -- the last three of my five

years, I was a single-issue science advisor, I was not OSTP director, effectively. I relinquished -- not formally -- but I basically made that low priority and I gave it to everybody else to do, because I was asked to do only one task. So you do both.

I think also there was a wonderful thing done by that act of Congress, and that's not very often appreciated. They gave OSTP its own basic budget. It was appropriated just like the Pentagon is appropriated. You go and fight for your budget instead of sharing the White House offices' own budget.

DR. PIELKE: Today, we talked a little about some of the tensions that can arise, and we've seen this with the other science advisors who have visited, that many in the science and technology community see the science advisor as their representative in Washington, and their job is to fight for budgets. And at the same time, another job of the science advisor is to work for the President and implement the President's agenda, which may not necessarily be the same agenda. Can you talk a little bit about those tensions and how you saw them?

DR. KEYWORTH: I didn't have those tensions. If you allow them to develop, they will. I cannot tell you how many times in the first year I had people who considered themselves, you know, statesmen for science, tell me -- try to give me orders.

I can tell you some very distinguished, outspoken, very accomplished scientists who never, again, got through my phone. You can't do it. I mean, if they're mutually exclusive, they're octagonal. If you are seen for one second as pandering to people on the outside, you will no longer be credible.

And I'll tell you an interesting story, which actually is embarrassing, because I certainly was one of these. But one day, somebody came running into my office, I guess the second or third year, one of my senior staff people came running into my office and wanted to see me. And he said I had to do something, "You've got to do something. David Stockman just had an interview downstairs in the Indian Treaty room, and he was asked about trough behavior; behavior at the trough." And he said, "Of all the pigs at the trough that you have to deal with, which are the ones that have the most voracious appetites?" And he said, "Well," he said, "you know, I can answer that question correctly or incorrectly, but I'm going to tell you, they're one of my favorite pigs, that they are the best feeders at the trough and they're the scientists."

And the guy came to me, my staff came to me, and he said, "You've got to go down there and defend us." And I said, "Why? He's right. We are." And I was one.

DR. PIELKE: In your efforts to manage the federal budget during the time when the Reagan Administration was trying to limit budget growth, you tried to implement excellence as a criteria for evaluating research projects, rather than say an across- the-board budget cut. Could you talk a little bit about your views on how well that succeeded and the role of excellence in evaluating research projects across different agencies?

DR. KEYWORTH: I'll tell you how I think it worked to this extent, and this is a cop-out, but it's true. The place where excellence is pretty much protected is in basic research. I mean, academic research in science -- that's all I can speak of -- is a pretty hallowed

meritocracy, and it's pretty intrinsic to the system. And I'm not talking about the peer review system or anything else. It's intrinsic to the ethics and why people go into science.

And what we did was, our predecessors -- every administration has a reaction -- our predecessors, the Carter Administration, had to deal with some tough energy problems, and it started to put a lot of money into energy programs and into the economy. And by the time we came into office, it was decided that this was not going to continue.

So, basically, we had a -- by the time I got there four months later, we had some huge cutbacks in energy programs in particular. And so, it was very easy to sell a big increase in basic research because it was small potatoes compared to come of these big industrial projects.

And so I guess I was -- I pushed for this, because I was really concerned about the erosion of excellence in basic research. That was my motivation. I started seeing things like the Isabel Project, a big particle physics project that was pushed for Brookhaven National Laboratories on the basis of the East Coast deserved its turn. That's mediocrity; that's not excellence. Excellence is not about regional distribution or being fair or anything else. It's about merit.

And so I gave my first speech ever at the National Academy, and I talked about the erosion of excellence in science. So I came with that philosophy.

But the reason I think we were able to make it work wasn't because I was so smart. It was because we focused on basic research, where excellence is intrinsic.

DR. PIELKE: If I might get you to comment, I would bet that at the time now the President is working his way through the State of the Union and some of the buzz has been that he's going to talk about the new National Research Council report Rising Above the Gathering Storm, which is about US competitiveness, and talking about the new initiative that wishes a number of Congressional bills to stimulate research and development in the US.

Given your remarks about directed spending from science and technology to stimulate economic growth and so on, what are some general comments you might offer on the sort of expenditures the government might make to help the economy in the area of science and technology?

DR. KEYWORTH: I'll make a negative comment and then I'll make a positive one. My negative comment is the National Academy and the NRC have done some marvelous studies, and they were a very powerful tool to explore problems for me. They know absolutely nothing about the economy and industry and competitiveness. I'll make that negative comment.

Number two, I think you've got to remember a few basic rules. And one of them is that there's a history of what governments do well; not just our government, but all democratic governments, at least.

Basic research, which is very much an American concept, has been a 50-year success story -- 60-year success story. That's all I can say. It's been an enormous return on the dollars for

any way you want to measure it. It's just been a superb story of glory for this country. It has resulted in extraordinary talent.

By the way, it's not just educated American people; it's educated the world. It's a great success story.

I would basically make the argument that every attempt to try to stimulate a more competitive position in a given area of industry is constantly focusing on yesterday's loser. And you never pick the ones that are emerging.

There is an enormous amount of money in this country in industry to drive winners. And by the way, American competitiveness -- the others are beginning to compete, but I ask you when you ask yourself, either the strength of our economy, the strength of our high technology economy in particular, there is no longer a question of who's number one. I ask you the tough question: Who's number two? That's how far ahead we are. So I'm not really terribly worried about it.

But the third thing I wanted to say is that where the government has had a huge impact and a very beneficial impact, is when it acts as an enlightened customer. And a classical one is DOD. The Department of Defense, and especially in the period from the end of the war until the middle 70s, took a most enlightened attitude towards meeting its needs.

Now, you know, we'd like to say, if you look at a couple of great universities, MIT and CalTech, you'd like to say, "Well, these are the results of the National Science Foundation and Vannevar Bush's policy." That's not true. MIT was built by the Air Force; CalTech was built by the Office of Naval Research.

And the DOD was not investing in people. They were investing -- I mean, in education, excuse me. They were investing in making sure that the body of talent that they needed to meet their very comprehensive requirements were there across-the- board.

And so for a while they were a very good customer. Now, times have changed, because most technologies are much more dual-use than they were in that particular 30-year period. I mean, everything is becoming digital, and everybody's digital, and suddenly the inside of a submarine doesn't look very different from my desk. In fact, actually, being a director of Hewlett-Packard company, my desk is a lot more sophisticated than any submarine is.

But, seriously, I think that you've got to look -- the government can be a heck of a stimulating customer, through DOD, through NASA, through the Department of Energy, through all of its legitimate facilities: NOAA, NCAR, all of these can have strong economic impact by creating a demand to stretch.

The space program has had its high points. Now it's at its low point, but it has had its high points where it has helped to stimulate the economy.

So when the government acts as a customer, it can be a great stimulus. When it acts as a stimulus, it's a flop. And if you want to see how it fails, look at how Japan's efforts to do so failed, look how Japan is strengthening and has been strengthening steadily as they have

become less invasive. Look at the total failure of France and Germany's efforts to try to stimulate economic growth. Look at the attempt in the middle 80s to try to develop the micro-electronics industry when the barriers to entry were so enormous and the winners had long ago been picked.

DR. PIELKE: Well, this raises, I guess, a fundamental paradox. You know, as you suggest, in the early years, the Department of Defense was driving a lot of the push toward research in this country. How do we reconcile that with your previous statements about basic research being so important? Because the Department of Defense, if anything, does not have a basic research mission. It's very mission-oriented and focused.

DR. KEYWORTH: That's a very good question. So then you ask yourself why do you do basic research. And I do basic research because it's like art; I like art. But there's a very practical reason for doing it. It's because the way you train the very best people in the world is to train them in an environment where it's all inquiry. Just nothing practical, just advancing the state of knowledge.

And DOD was smart enough to realize that. Of course, by the way, remember all the scientists in the country worked on defense during World War II, so they all had sort of a vested participation in shaping how the DOD would continue to work in peace time. And you had not bureaucrats, but participants, real scientists. And they supported those universities because they wanted the world's best talent out of those places.

Basic research is not -- my own bias about art, but basic research is immensely practical.

DR. PIELKE: Let me follow that up. There's been a lot of talk which comes up, it seems, every 10 years, every 15 years, that the US is facing a shortage of scientists and engineers and, in particular, an NRC report I mentioned raises that issue. Do you think the United States, in the context of India and China growing and developing, faces a competitiveness issue with respect to the number of trained scientists and engineers in this country?

DR. KEYWORTH: Yes and no. I think -- you never have a good balance between supply and demand, but you know, in this country we always meet that supply and demand because the top people in the world come here. They don't go to Europe; they come here.

I read a projection last year in The Economist, that said that, over the next 50 years, they expected 80% of the educated immigration of the world flowing generally north, will come to the United States and 20% to Europe. So we are a very appealing place for one reason or another to these people.

And so we -- I'm not sure all of it is education. Some of it is the quality of parenting that we do in this country, by the way, but it's not all institutional. But we constantly have a renewal, and it is the source of America's success. There's no question about it. All you have to do is go to Silicon Valley.

I used to get beaten over the head when I was science advisor constantly by Congressional committees, not science committees, I mean everybody. I was fair game for anybody on the same subject of, why was it that at MIT, for example, if you look at the

graduate school, the top four people were Chinese, and you have to get down to the fifth person before you found a single American-born person. I gave them the same comment. That number five was a lot better than he would have been if he hadn't had those first four.

DR. PIELKE: Maybe we could return to the issues of competitiveness when we talk with the audience. I do want to turn to a couple of other subjects before I'll let you off the hook here.

The space station program had its birth, I guess, during your tenure, and a few of your comments I think that we pulled out were remarkably prescient, I think, with respect to the station. You said that, "you had yet to see competitive, well thought out plans, not only for what the space station would look like, but what it would do." You called it a "motel in the sky" and a "lead balloon."

Twenty-three years later, the director of NASA, Michael Griffin, acknowledged that the space station was probably a mistake. What are your thoughts on space policy, both during your tenure, how the decisions were made, and where we are now and where we might be going? That could be an hour or two hour lecture, but --

DR. KEYWORTH: I'll tell you pretty fast. I think the space policy that developed the Apollo project was a stroke of genius. There were a few very, very visionary people. President Kennedy was part of it, George Lowe, the administrator of NASA at the time, was part of it, and they were absolutely brilliant. And there has never been a sound space policy since.

And by the way, I'm as guilty as anybody else in that process. Space policy was on my plate for the first several years of my term in OSTP, and I did not -- I basically staffed it with someone else. It was not the number one thing on my plate, but we blew an opportunity on two fronts.

One was, we were successful in delaying the space station for four straight years. It was only the second election that would give everything to everybody. And the people who managed the election are the ones who decided finally that the President was going to start talking softly about the space station.

But we never put any -- the President never said a good word about the space station. We didn't put anything other than Jim Berry's study money in there, and I went out constantly and said bad things about it.

So we stifled it for quite a while, but the other thing was the shuttle. The shuttle was -- if you go back and look at the literature in the middle 60s, the scientific community was largely violently opposed to the space shuttle. The space shuttle was a product of the military industrial complex that had this 50s- era technology that they wanted to get out in the marketplace, period. And the shuttle has been a disaster, not just because of the -- not, I should say, partly because of the tragic losses of civilian life that occurred, which was a gross misjudgment to ever think of putting a civilian in something that is much more dangerous than a test military aircraft.

Number one, a rocket is an "accident waiting to happen," is a quote I remember. Number one. So we should have developed at that time a single stage-to- orbit launch vehicle, and it's something we're not going to have a space program until we do it again.

We did Sky Lab in the 70s; the space station is just a repeat of Sky Lab. The American people look at the space program, they look at every shuttle going off, they think, "This is America at exploration. This is American technology pushing the forefront." This wasn't American technology pushing the forefront. This was 60s technology being subsidized.

We could have done this manned Mars mission. I was all enthusiastic about the manned Mars mission throughout my entire five years. It was clearly the thing to do. It was a challenge, it was a stretch, it was exciting, it's something that we could do, and the manned versus un-manned argument, any scientist will tell you you don't need a man. But, you know, we work for the American people and they're the ones paying the bills and they want manned, so we're going to have manned. I think it's perfectly rational. It's the way it should be, so we'll do it.

By the way, I don't think we'll do it in this administration. I don't think they have a plan, I don't think it's a high enough priority. There's got to be a plan. I mean, you've got to say is the Moon or an Earth orbiter going to be the launch point? Exactly how are we going to do this? And you've got to give some rationale for it and build up public support; sell it to people, make it serious.

But we have not had a space policy for a long time, and I think the American people like space research and space exploration.

DR. PIELKE: Today in class, you had some comments about NASA sharing a human space flight mission and basic research space science mission. Could you say a little bit about that combination?

DR. KEYWORTH: Through most of NASA's history, they have done basic research only when it was, pardon the expression, crammed down their throats. And once in a while, that has worked.

I have one favorite experiment, the detection of gravitational radiation, which is a beautiful experiment, it was successful. I mean, we practically told them we'd replace the administrator if they balked on it. It was that hard to get it down their throats, but it was -- by the way, it wasn't that expensive. It was a few hundred million dollars, and it was a single issue.

But NASA is a creature of the military industrial complex. And, in fact, as I said to you today, and I'll say it more openly, we will never have, in my opinion, a successful man-to-Mars mission in NASA. It's going to have to be built in Agency Alpha. They will never do it in NASA. NASA is like a child that got spoiled and it turned rotten.

DR. PIELKE: There's a lot of space scientists and others in the Boulder community, so maybe that's another topic we can return to.

DR. KEYWORTH: Twenty years ago when I said things like that, I was radical. But I don't think I'm very radical anymore. There are not many people in Congress who will stand up and defend that anymore.

DR. PIELKE: We've asked all of our science advisors to comment on the allegation that the Bush Administration is a serial misuser of science; that they engage in the politicization of science. And I wonder, to the extent to which you've been aware of that number of science advisors have been asked to sign on to statements and so on, and what your thoughts are about the Bush Administration and the buzz that's around?

DR. KEYWORTH: First let me say there are a lot of things the Bush Administration does that I don't like, but I think that's just unadulterated nonsense.

Jack Marburger is an extraordinarily honorable man, he is a man with a long built up reputation. I know him personally, I respect him tremendously.

I give you one example. I mean, it's a position that he took on -- I can hardly say the word. It's hard for me to say it. "Intelligent Design," and was a man of instantaneous honor. He is -- and I think it's just, you know, politics.

DR. PIELKE: All right, a few questions I promised I'd ask for our grad students, and then we're going to move to the audience questions.

What do you think the most positive benefits are going to be from the rise in India and China's science and technology capabilities?

DR. KEYWORTH: Talents in market. I think American industry and technological capabilities will continue to be drive by Indian scientists. Probably, you know, we started with Chinese scientists first, and probably for a while it will be more Indian scientists than Chinese. I think you're going to see big markets develop in both countries for our technology.

I think these ridiculous discussions, economically ridiculous discussions about outsourcing taking American jobs and so on is just plain foolish. What we're doing is moving out the jobs that don't pay enough to support our quality of life, and we're moving them to much lower cost economies.

So I think it's just the healthiest thing in the world, besides the fact that the only way you're going to turn corrupt -- I mean, India is pretty corrupt and it's not, but we think of it as a Democracy, and totalitarian regimes, such as in China. The only way you're going to get the power of distribution of economic pull, to stretch them away from centralization, is through economic growth.

I think this is all incredibly healthy. I think China is a long-term big problem, by the way. I think we can't -- I've spent a lot of my life dabbling in China, and I have lots of Chinese friends. I choose to respect China; my son is a Sinologist.

But, China is a big risk. If we play that one wrong, it can be very dangerous.

India is much less of a problem. They shot their wad with an incredibly clumsy move of their nuclear weapons test, and there are a lot of things between the United States that you'll never read about; not for a long time to come, but I think that's fairly stable.

DR. PIELKE: All right, jumping around to another topic. What do you think about the increasing commercialization of university research environments and the focus on patents and university professors having companies on the side that may be worth tens of millions of dollars, and so on?

DR. KEYWORTH: Well, I think that part doesn't bother me. I think entrepreneurialism is a renewal force, and entrepreneurs and campus are great. You see it a lot in biotech, and I don't see negatives.

I'll tell you what I do worry about, and I'm -- this is a confessional. I've mentioned before one of the programs we started was NSF centers. And one of the ideas of mine was that if industry has a lot of really tough problems they need to solve, you bring them into the academic environment. I'm not so sure that that was a good idea.

I watch now from the Hewlett-Packard company and so on, and I'm not so sure that the influence of industry is a hundred percent good. I worry in the long run about deteriorating the quality of the academic inquiry process, I worry about too much practicality. I'm not worried about the entrepreneurialism and a rich faculty member is a great idea as far as I'm concerned.

But, I worry. I'd hate to see -- you know, businessmen have -- I've already said what I think happens when government has their responsibilities and starts to meddle in industry. It's bad, but I think industry doesn't really -- they want to hire the best possible students, but they don't really understand how to train people.

I have never -- and I'll say this categorically. I don't know a businessman -- and I know a lot of businessmen and I've worked with lots of them when I was science advisor -- I don't know a single one that understands basic research, you know, the whys and wherefores, and so on. So I'd caution you here.

DR. PIELKE: It's been a while now, but it keeps coming in discussions, in science policy discussions, and that's the termination of the Office of Technology Assessment, which was a Congressional staff agency. What were your views on the termination of OTA?

DR. KEYWORTH: A mixed one. I was -- Bob Walker was a very, very close friend of mine, and we co- authored some things, and he asked me a lot of advice on this, and I was lining up somebody to run that office for him.

I think on average, it was probably a mistake. I don't think OTA was a very effective office. I don't think it had the kind of skills that the National Academy and NRC do. I don't think that it was always as independent as it could have been. But nevertheless, I think it was a net plus. So I think it should have been fixed and strengthened rather than removed.

DR. PIELKE: All right, my last question. In today's context of political and policy issues related to science and technology, what advice do you have for scientists, students, academics that you're talking to tonight, government scientists, others, about engaging in the political process and understanding policy?

DR. KEYWORTH: Well, I already said one thing. I think you've got to, when you're selling to somebody, you've got to put yourself in their shoes and not sell them your goods. We scientists always try to do that, but I'm going to say something I've said to several other people today in our discussions, I think we're entering into a different kind of period of science policy than we're used to.

I think we're entering into a lot of problems that are going to take 30 years of public debate. And I pick a number, because what I mean is many, many administrations -- we know how to solve problems of, you know, ignore defense and fix it in eight years, and I think we do a pretty darn good job of responding to diseases, for instance,and so on.

I'm not worried about things like that. I'm worried about big huge problems that are multi-dimensional; complex systems, effectively. I'm worried. Global warming is one of them.

I think there are social issues that are technological that are going to arise; I can't define them yet, but I think they're inevitably going to rise with genetically tailored solutions for medical problems.

I think we're coming to a whole bunch of problems that are going to require a fundamental educated national debate for a long period of time, and I think we used to do it pretty well. I don't think we do it very well anymore. And I think you guys, universities, are part of the problem. I think this whole concept of political correctness on a fundamental complex debate, is just plain cowardice.

And, I mean, the issue of global warming, you know, is not an issue of real men save the world, and some people care about the future and some people don't. There's an extraordinarily complex set of causalities there. We don't understand them yet.

We started a problem in our time -- and by the way, it was lucky. Believe me, we didn't have the vision to do this, but that's the Earth Orbiting System, EOS. This is a system to collect data not just from satellites, but from Earth-based systems and to assemble a massive database. This is the day of data- mining, you know, the ability to simulate anything.

We can crack this nut for sure, but we're not going to crack it by saying, "Real men sit here and wimps over here, or selfish people here and unselfish people here." So this political correctness that has crept into universities is a plague in trying to help drive this kind of constructive long enduring public debate.

DR. PIELKE: All right, and with that, we're going to turn it over to you guys for questions.

And just so, for those of you who haven't attended the other six events, we are taping this, so we're going to have to repeat your questions.

So we're going to ask for concise questions that can be easily repeated. Either Dr. Keyworth or I will repeat the questions. So right here is the first.

(male asks question)

DR. PIELKE: So the question is, what, Dr. Keyworth, is the greatest issue going forward between the US and China in their shared relationship?

DR. KEYWORTH: There's one problem: War. I mean, fundamental conflict over fundamental different interests. Taiwan, whatever. And it's got to be avoided at all costs, and it can be avoided at all costs.

I think that the overlap that we have with China is huge. That is, I'm talking about shared interests. I think that China has benefited unbelievably from its opening to the West through activities that were initiated in the Nixon years. They've benefited hugely. But there have been some very tough times.

I'm not an expert on the balance of what's going on between the military and the civilian government in China, but it's pretty complicated. And that incident that happened five years ago, you know, with shooting down our intelligence airplane, was -- I mean, that kind of thing has triggered wars.

And Taiwan is a very touchy thing. So we've got to manage something of a very high priority. You know, we've got so many people in the State Department 15 years later, who still are Sovietologists. And one thing you've got to remember about Sovietologists, first of all, they never did anything right, they never predicted the fall -- they never said that the Soviet Union could fall, they never got into the heads of the Soviet Union, so when Mikhael Gorbachev was born -- or I mean was in place, for example, he was a total foreigner to them all.

So they didn't even -- they weren't even a successful academic discipline, and secondly, they viewed a world that no longer exists. And what we need is a much stronger body of talent that understands China.

I think China is much more complicated to deal with than India. And so I think we have to, you know, make it a very high priority and we've got to develop a lot of skilled people.

DR. PIELKE: In the back on the stairs.

(male asks question)

DR. PIELKE: So the question was to ask

Dr. Keyworth to reflect on Ronald Reagan's views on alternative energy research and where we might be and where we're heading.

DR. KEYWORTH: Well, my own opinion is that if we had continued to subsidize things that were not economically feasible, we would have been disincentivized from trying to find alternative energy sources that were more economically feasible.

We continue to invest a lot of money in the Reagan years in some technologies, but what we were not trying to do is to subsidize well-known technologies. We think the government -- President Reagan felt that the government should invest in research and new ideas, and not in pushing uneconomically viable energy sources.

So, where do I think we'd be? I think we'd be much farther behind than we are right today if we had continued to push a lot of those subsidized alternative energy sources.

DR. PIELKE: And the second question is where do you think we're headed, I guess.

DR. KEYWORTH: I think we're headed into an area where, I mean, I think we're going to see -- I think we're finally at the point where we're starting to see a lot of environmental groups beginning to support nuclear energy as a temporary solution, temporary 100 year solution, to some of our needs. I think we're going to -- I heard otherwise today, but I think that hydrogen is going to start to be a much more important technology in lots of different areas.

By the way, I do think that hydrogen as a fuel can be very valuable in a lot of areas. We're not going to build a single stage-to-orbit vehicle, for example, without improving a lot of our hydrogen technologies. Whether we build a complete hydrogen infrastructure or not, I don't know, but hydrogen is actually less -- liquid hydrogen is much less volatile than gasoline is.

So, you know, it's not that scary. I think we're reaching a point where people realize we've got to do something. There's not a whole lot of incentive, you know, when you've got gasoline selling at $1.25 a gallon.

You may think it's strange for a Libertarian like me to say this, but I'm all for a huge gas tax. I think it's the only tax I can think of that I like, so, and because I think a gas tax would just increase the incentive.

DR. PIELKE: Right here in the front?

(male asks question)

DR. PIELKE: The question was to what extent Edward Teller was involved in the SDI discussions?

DR. KEYWORTH: Edward Teller was, of course, my mentor and my friend and everything else, and he was very much involved in the discussions on my science council.

He certainly was not involved in any way talking to the President about it, stimulating it. He had a concept that he had sort of become almost theologically committed to, called the X-Ray Laser or Third Generation Nuclear Weapons, which were exactly the opposite of what President Reagan was trying to do.

President Reagan was trying to, as he said in his speech -- his speech talked very little about ballistic missile defense; it talked about reducing our reliance upon nuclear

weapons. And the last thing in the world the President wanted was orbiting nuclear weapons up there.

So, I mean, I confess. I can say it now, all these years later, that's why we have these talks, one of the biggest and most difficult problems I had was this problem of, in fact, that Edward was my mentor and he was very much admired by the President. You know, if Edward had not fought to get the hydrogen bomb built, the world would have been a very different place because the Russians built a lot better hydrogen bomb than we did about six months after we did.

So it was a very close call, and the whole American scientific community was against doing it. So it was a very close call, and Edward was a very courageous man and the President liked him very much, but he was the bane of my existence on this one.

DR. PIELKE: Up on the top there?

(male asks question)

DR. PIELKE: Well, I'll let you rephrase that.

DR. KEYWORTH: Okay. Let me rephrase it. First of all, you know that the scientific community was largely opposed to SDI; that's correct. How did we get funding for SDI nevertheless in the Congress? And there's something going on today, how is that going on? Is that a fair rephrasing?

MALE: Yes.

DR. KEYWORTH: Okay. First of all, the fact that the scientific community was opposed to it is only marginally relevant. There aren't really very many scientists, and we really don't represent a very large part of the voting population.

And the credibility that the scientific community had in the Congress on defense, in the 50s and 60s and early 70s, just isn't there anymore. We don't have the Johnny Von Neumanns and so on who are standing up there as, you know, people really responding to issues.

The scientific community became very, very pacifist oriented, and you know, the House Armed Services Committee is not going to sit there and spend a whole lot of time being swung by a bunch of pacifists. So their opinion was not all that high on the matter.

Secondly, the deal -- the concept they were opposed to was a concept that nobody was actually talking to. They were arguing that you cannot build a perfect defense. And as any scientist knows, you really can't build a perfect anything.

And what was proposed, instead, was to build a system that simply complicated targeting to the extent that nobody would have the incentive to make a first strike. And this is-- a ballistic missile defense system that's 20% or 30% effective absolutely complicates it.

So they were talking up here of some idealistic thing, and in fact, we were sitting over here proposing to do a completely different thing. So it wasn't very relevant.

The money that was in it initially was -- we had, you know, we had a $400 billion dollar defense budget, whatever, $300-something billion dollar defense budget, and we were spending a few billion dollars on SDI. It's pretty rare, a President as popular as Reagan, whose Congress is going to try to fiddle around with that, and we had a pretty strong Republican Congress, so we didn't really have very much trouble selling it.

Now, going to the other point was -- and by the way, if you remember what happened, President Reagan proposed SDI on March 23, 1983 and a couple of months later, Chernenko, who was the secretary general of the communist party, head of the Soviet Union, somebody nobody had ever been sure that he actually was still alive when he was appointed, he died very quickly.

And then Uri Andropov, who was the head of the KGB for a long time, came in and he became secretary general. The minute he was made secretary general, about three months after SDI, he came out and was -- he was so aggressive against SDI that an awful lot of people in this country said, "There must be something good about it."

And so we had this phenomenal salesman over there. Unfortunately, he died a few months later. This is when President Reagan made the famous statement, "How can I deal with them when they keep dying on me?"

But, anyway, so we had this wonderful sales force going on over there, but finally, coming to the modern part, I do not have the slightest idea why anybody is trying to do an SDI today. SDI was a ballistic missile defense system, okay, against this very complicated eroding stability that we faced in 1981. That doesn't exist anymore.

Now you have a different kind of threat. On ballistic missiles, you have a threat from Iran, you have a threat from North Korea, and I am reminded once, twice today, but I'm reminded of giving a speech at the Kennedy Center on what the President intended by SDI just a few weeks after the speech. And I said, "You've got to understand, ballistic missile defense is like this: It's broken up into three components. You have three opportunities to intercept a ballistic missile. You have the boost phase, when it looks like a Roman candle and you can see it from thousands of miles away from space, and it cannot be hidden. You know, it's like a shuttle being fired off, and that's one opportunity. You don't even need to know where it's aimed; just destroy at that stage.

Then you have a very quiet stage, when it's going through space very quietly, very difficult to see, but you have a long time within which to intercept it.

And then you have the third case, where it's re-entering through the atmosphere and before it strikes its target. So you have boost phase, mid- course, and terminal intercept.

And a general was in the audience, a very, very distinguished general, Glen Kent, who had been one of the architects of post-War deterrents, stood up in the audience, and he said -- and I know him quite well. He stood up in the audience, and he said, "Jay, I think you're missing the really important point." I really couldn't imagine what I was missing. It sounded like beginning to end.

And he said, "You're missing preemptive interdiction," which is the fourth phase. Anyway, he was absolutely right that in most of these -- take Iran, for example, you know, rather than build a ballistic missile defense system for the whole world against Iran, which would be unbelievably complex, you've got two choices: defend Israel, the most likely target. That's a terminal defense requirement. Israel, to some extent, is doing that, and ultimately this may be something that we would get involved in. Or, the other one is, do what the Israelis did to Iraq in 1981 when they went in and took out an Iraq reactor.

And, I was saying to some people this afternoon, it was my first tough job in the government. Everybody was in California in August, I think, of 1981, and I was asked before the White House Press Corps to tell them the President's position on the Israelis taking out this Iraq reactor.

And I looked at all of the intelligence and it was blatantly obvious that this reactor had no purpose other than to develop the material for the Iraqis to build a nuclear weapon, and the Israelis shared with us their intelligence, we shared ours with theirs, and they acted without telling us anything about it.

And I looked at it and I called Ed Meese and said, "What do I do?" And he said, "Why ask me? It's your job." So I went and stood before all of these tough people, and I said, "It was an act of defense. We do not endorse attacks upon sovereign nations; nevertheless, on any rational basis, it was a justified attack."

And the President came back and said to me the next day, after he came back, he said, "You know, I wish I could have said it so succinctly, but," he said, "that's exactly what I would have wanted you to say."

And I'm afraid we're going to have to get used to things like this, because you cannot possibly -- you cannot take even the smallest risk of a nuclear attack from one of these lunatics.

A nuclear weapon, the result from a nuclear attack, a single nuclear weapon, are a lot greater than most people think. I mean, they will cause irreversible damage on a Western country.

So the bottom line, the SDI things that they're talking about in Congress today, I don't have the slightest idea what that stuff is about. They are not defining a practical challenge.

You cannot protect the United States; the land area is too big. You've got to develop a boost phase intercept capability, or you've got to take it out through preemptive interdiction.

You cannot do area defense over an area as large as the United States. Yes, you could protect this campus, you could protect part of Colorado, but you cannot protect the United States with any technologies that we know.

So, this is the case: Every time I've ever been asked to testify in the Congress on early stage deployment of SDI, I never -- I've always denied going up there, because we don't have anything to deploy, we don't have a challenge well-defined.

(male asks question)

DR. KEYWORTH: What would I advise if I were the science advisor in this Administration to the President and his team on the subject of global warming, okay.

I`ll say a little bit, but you know, I have to confess to not being up to the state-of-the-art right now. When I was in there, I started this National Academy study with Bill Nuernberg chairing it, and we kept track of it and kept it going for three years. I had a constant feed with people thinking on it. I'm not up to that kind of speed anymore.

But, I still think there are huge uncertainties in the science that we have. I would be pushing very aggressively that we invest and strengthen the database that we have. We've got to understand a lot more about what is going on in the oceans, we've got to understand a lot more about what possible solutions there are, and I'd want to have it be a constant study of discussion.

Let me give you an example: In our administration, one of the most exciting -- I know it sounds horrible, but one of the most -- from a scientist's point of view, one of the most exciting challenges that came up was HIV. Scientifically, it's an unbelievably interesting problem.

And we had constant bringing in of 10 or 12 of the leading scientists in the world, and sitting down with the President for two hours at lunch and just talking about nothing except what had happened in the last 12 months in human virology and immunology as a result of the study.

And I think you've got to have that kind of debate going on. I don't know what's going on. I think it's a pretty reasonable priority for Jack.

DR. PIELKE: Jack Marburger?

DR. KEYWORTH: Jack Marburger.

DR. PIELKE: Let's take one more question. How about –

(male asks question)

DR. PIELKE: Privatization of space technology?

DR. KEYWORTH: I already told you that I don't think NASA can cut the mustard in developing a meaningful space program.

I would love to see some real privatization take place. I think the single stage-to-orbit vehicle is a marvelous opportunity, as I'm just not at all sure that Boeing and Lockheed are the places where that's going to get done right.

There've been some marvelous new things done, as you know, by Burt Rutan and funny people like that, so, you know, I kind of like that idea that came up some years ago, you know, put out a big prize.

But certainly you can do what -- certainly you could do in a new agency what the Department of Defense has slowly learned how to do, which is to go out and sort of incubate new companies.

For example, you turn on the boob-tube, the television all the time these days, and you're seeing these missions like last week. You see a predator airplane going in and taking out some terrorists in Pakistan, and you saw them take out the perpetrators of the USS Cole incident and so on.

That predator airplane wasn't exactly built by Lockheed nor was it built by Boeing. It was built by a little company called General Atomics.

And I think the space program needs to do two things: I think it needs to do some start-ups, you know, some people with no installed base, no bad blood, and I think you need to do the best thing you can to stimulate privatization of space.

But, you know, you can't fool yourself. You're not going to solve this problem by pure economics. You need some new institutions.

DR. PIELKE: All right, with that, why don't you join me in thanking Dr. Keyworth for a wonderful evening.

(applause)

The David proceedings were transcribed from a digital recording and reduced to typewritten form by Christopher Boone, Digital Reporter.