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QUESTION, Professor King: I have a question for Dr. Williams, that is quite important from the standpoint of the international context in which the United States finds itself. The United States spends a lot of money on defense R&D. Some people say it has side benefits, other people question that. Regardless of which side you are on, it represents an enormous expenditure. Do you have any comments on the effect of this to the U.S. position internationally and commercially?

ANSWER, Dr. Williams: The federal government presently spends approximately $63 billion a year on R&D, about 70% of which is defense and comes out of the Defense Department. Clearly in the past, major innovations and new industries have developed as a result of this, for example, in electronics and aerospace. The downside is that it absorbs a large percentage of the scientific and engineering personnel in the country on defense-related, i.e. weapons-related, R&D and away from civilian applications.

I see a very definite change in the Defense Department. We have been working very closely with the Defense Department over the last couple of years toward conscious upfront applications of defense-related R&D to civilian technologies. For example, there is an interagency working group on flexible computer-integrated manufacturing. The Defense Department is playing a major role in this working group by trying to get flexibility out into the private sector so that a company can make not just gun barrels, but similar products for civilian use, interchangeably as fast as possible. The bottom line is that military security and economic security are becoming the same under overall competitiveness.

QUESTION, Mr. Fay: The United States has spent a lot of money on oil shale and Canada has spent a lot of money on tar sands, but neither of them have really gone anywhere. I was wondering if there is an area where we should be talking and working together on this innovative technology?

ANSWER, Mr. Blackburn: There are different kinds of technologies. Oil shale technology is quite different from the tar sands technology. We are producing probably 150,000 to 160,000 barrels a day from the oil plants. An expansion of both those capacities are planned. So it has led to something in Canada that certainly made sense in the oil price days of the 1970s. The United States would probably not start down that road at this point, because the United States has a different problem in shales.

COMMENT, Dr. Williams: I am not familiar with the area, but I would say on principle, that the more cooperation across national boundaries, the better.

QUESTION, Mr. Bradley: May I answer the question? The Department of Energy has a general view on heavy oil and tar sand research and development. In fact, the working group was discussing that on Thursday as I was leaving town, so I do not know what happened, but I would be pleased to get in touch with you and tell you more about it.

My questions for Jack Williams relate to the Technology Administration. First, what is new, what is going to be different? Second, have you heard anything recently about the specific people who might be appointed, either as the Under Secretary for the Science and Technology Administration or as the Science Advisor?

ANSWER, Dr. Williams: The answer to the last question is no. There have been rumors floating around, but for the positions of Under Secretary and Science Advisor, those rumors suddenly ceased about a month ago and I do not know why. I would assume that the people who were identified at that point may no longer be potential candidates.

With respect to the first question let me give you some quick background. The Technology Administration is essentially an elevation of the importance of science and technology to competitiveness, at least in the eyes of Congress, and I think in the eyes of the Administration. The Technology Administration takes the position of Assistant Secretary and elevates it to Under Secretary, and under the Under Secretary it puts in a couple of major organizations, the major one being the National Institute of Standards and Technology, formerly the National Bureau of Standards. As to the direction it is headed in, I think we are going to have to wait for a new Under Secretary, because that is the key.

I might also mention that there is a gentleman by the name of Tom Murrin, who works at Westinghouse and has been rumored to be the next Deputy Secretary. That would bring a tremendous degree of skill, to add to the notable skills of Mrs. Deborah Wince-Smith and the Deputy Under Secretary, Lee Mercer, two people with formidable skills.

COMMENT, Dean McNiven: I would contend that at the federal level in both Canada and the United States, since the recession, there has been a considerable amount of both partisan and policy confusion over the notion of industrial policy and what the role of government and industry ought to be. Yet, at the provincial and state levels this has not really occurred. Since 1982, almost all the states and provinces have tried a variety of things.

I wanted to put forth that contention, because it strikes me that the new federal government in Canada is moving more towards the old Reaganomics stance, while the new U.S. government in Washington is moving towards a more activist stance.

COMMENT, Mr. Blackburn: If that comment means that we are

not going to try and solve the problem with federal spending, I agree. We are not rich or smart enough as is shown by the problems that the governments have had over the 1980s with different kinds of spending programs to try to buy a modern technological industry. We see our role more as a catalytic role. It will cost us something, but not only can we not afford to buy the game, but Mr. Wilson, our finance minister, is making it clear that we do not have the resources to do it.

Second, it would probably not be effective if we could. The only way for us to be effective is to bring together whatever the government, the key industrial players and the university community can contribute to the gain in science and different technologies and skills and try to work together on some sort of a common approach.

If in going through that exercise it looks as though it will require a massive injection of all kinds of limited resources, I suppose that would be addressed at the time. But at this stage I do not think we would know how to spend a community budget. I am impressed with the commitment of resources in the European Community. Looking at the coverage, the fact that there are so many programs and the fact that we do not know which ones are going to be effective, we do not have the funds to permit us to take that type of community approach at this stage.

COMMENT, Dr. Williams: I just read a speech by Dr. Graham the other day and he said there were at least two major themes that he sees as the outgoing Science Advisor. First, he sees the Bush Administration moving towards a longer-term view of support for science and technology, citing capital gains tax, R&D tax credits, trust initiatives and those types of things. Second, he foresees more of a leadership role in the federal government in science and technology. Now, how that applies in a specific case is anybody's guess.

You mentioned state and local governments and the fact that many of them, unlike the federal government, have targeted industry standards such as biotechnology, information and new materials. Some of these standards are working and some are probably not working. A half a billion dollars is being spent in the states on science and technology matters; seed capital, venture capital, training, incubators, manufacturing. There is a lot of activity going on. Clearly, the two need to come together.

The government's role is to remove barriers, provide appropriate incentives, provide appropriate catalytic services and provide critical information to allow the maximum use of the resources that you have.

COMMENT, Mr. Blackburn: The role of the provinces in Canada, and also the states here, in the area of education seems to be one that constitutionally we are not able to address in Canada. A number of speakers, and I tend to agree with them, have identified basic literacy at primary and secondary levels and science education as a fundamental need in providing the raw material, the human resources that we are

going to need to effect this change. I think that we are both in appalling shape right now, and I would like to see the provincial governments in Canada do a much better job in that area than they have in the past. I think that is more important than fiddling around with industry tax incentives.

QUESTION, Professor Shanker: Dr. Strub said that he did not think enough resources were being devoted to fundamental, unrestricted research in Europe. Has that ever been identified as a problem by the Canadian or U.S. governments, and if so, were there any steps taken to rectify what might appear to be a disproportionate or inappropriate allocation of resources?

ANSWER, Dr. Williams: It has always been a problem, and I think the Reagan Administration has expanded the primary concept of basic research as the seed corn for industrial development in the United States. Between 1982 and 1990, basic research has expanded by 56% in real terms, which provides a very good statistical underpinning for the emphasis the United States has placed on basic research.

COMMENT, Professor King: This has been a great session, and I thank you both for laying out the actual and possible roles of government in innovation, which seems to be extremely important in terms of potential policy implications.