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Government Assistance to and Policy toward Innovation

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Council of Canada, as well as serving in the Ontario Government as Deputy Minister. He has an impressive record in Government, academia, and a background in mechanical engineering. For some of the questions earlier, I note that I was just on a high school senior trip with 20 high school seniors down in Mexico, graduating their pending graduation, and ten of them said they were going to go into engineering. So I was quite impressed with that. With that introduction, Tom, we look forward to your presentation.

CANADIAN SPEAKER

Thomas Brzustowski†

Thank you, Jamie.

First of all, let me say thank you to Henry. Henry, I hope you are not offended by this, but until the invitation came, I did not know the Institute existed, and I must say that if I had any doubts at all about the importance of the Institute, they were wiped away by the remarks at dinner last night. I just think that it is tremendously important that this Institute is here. In fact, my only regret during the wonderful introductory session this morning is that you folks were in the audience instead of the new cabinet of Canada. I would have loved to have had them hear what we heard hear from Kent and from David.

I am just going to make one or two introductory comments from here, and then I am going to wander up there and start punching buttons to put on a slide show. This is very much of a legal crowd, so let me warn you right away that you are going to be co-opted to aid and abet in a flagrant violation of the law of six, the law of six being that on a power point slide you can't have more than six lines and you can't have more than six words in any given line.

As a result of the wonderful introduction that we heard earlier, I have the luxury of being able to focus on just one sliver of the action, namely the impact of university research in science and engineering on innovation the way

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it is done in Canada. Innovation is something that is growing in importance in our country, and you have heard some of the reasons from David Crane: the fact that there are a small number of companies that do research, that do R & D. Let me state one possible reason very simply: we have not had a Vannevar Bush, who wrote "Science: The Endless Frontier,"[1] and we have not had a Harry Truman, who received the report and implemented so much of it.[2] That's 60 years ago. I see a strong imprint on United States policy, attitudes, practices, and culture of that splendid report so much of whose language is still valid today. We haven't had that in Canada, and as a result, much of what has happened to drive university research in science and engineering into economic prominence, and into political prominence has been relatively recent.

The last thing I will say in introduction is that when I talk about innovation, I am going to be talking about product and process innovation that fits with science and engineering. That's not to say that institutional innovation, complementary innovation, marketing innovation, and all the other kinds of innovation aren't important; it is just that this is my focus. I am very much taken aback in speaking to broader audiences, not scientists and engineers, but broader audiences, by the emotion with which people react to the definition of innovation. I have scars on my back from numerous meetings where the first comment was: “We hate your definition of innovation! You are saying we are not innovative.” It has become a pejorative to be deemed outside of the activity of innovation in some way. But without wishing to insult anybody, I am going to talk only about product and process innovation. Innovation has a generic definition, having two aspects: first a new idea, and then putting that new idea into practice. And in what I am going to say, the new idea is called an invention, and the putting it into practice is called commercialization.

I have to tell you right away that I have looked at this conference as a wonderful learning opportunity. Given my past and given what I do now, I have had the wonderful opportunity to reinvent myself, and that takes a lot of learning. I hold the Royal Bank of Canada Financial Group for first professorship in the commercialization of innovation; but, having just said that innovation is invention plus commercialization, that title doesn't hold a lot of

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[1] VANNEVAR BUSH, DIR. OF U.S. OFFICE OF SCIENTIFIC RESEARCH AND DEVELOPMENT, SCIENCE: THE ENDLESS FRONTIER, A REPORT TO THE PRESIDENT (1945), *available at* http://www.nsf.gov/od/lpa/nsf50/vbush1945.htm.

[2] *See, e.g.*, National Science Foundation Act, 42 U.S.C.A. §§ 1861-1875 (1950) (establishing the National Science Foundation as per the recommendation from Dr. Vannevar Bush); Harry Truman, President of the United States of America, Statement by the President Upon Signing Bill Creating the National Science Foundation (May 10, 1950), http://www.presidency.ucsb.edu/ws/index.php?pid=13480 (last visited Oct. 11, 2006).

water semantically. But we are not giving the money back even though the title is weak. We have to go with it.

The recent developments in innovation in Canada have happened largely since 1997, and there have been very significant increases in federal investments in that time, particularly federal investments in research at the universities in science and engineering, in particular, infrastructure, faculty programs.[3] Government laboratories have been left out of this.[4] In fact, since the election of 1993, the motto seems to have been: Inside Government spending – *bad,* outside Government spending - *good.* And the federal laboratories have suffered significant budget cuts, and they haven't recovered from those. Industry spending on R&D has been flat. This is spending by industry as opposed to the value of the research and development done by industry. And you can imagine there is a great deal of political pressure and policy now to give an accounting for the increased amount of spending on research in the universities.

The connection is to be made with new economic activity, and, of course, the focus then is on innovation, but it is not an even focus. It is as if industrial R & D didn't exist. It is as if development was not important. It is as if all the solution to the problems of connecting new knowledge with wealth creation in the economy rested on the commercialization of inventions arising out of basic research. We can speculate why that is, but I will stay away from that. Whatever the source of these perceptions, they are there. Now, the universities have responded by working hard to try to improve their capacity for commercialization, but they face a people shortage; I will show you that on a diagram of the system. In fact, the bottleneck is the shortage of people working in this area who can recognize an invention and take it to investors. And the structure of Canadian industry is such that the receptor capacity for research-based, intellectual property is quite limited. And that means that creating startup companies, science base startups, to commercialize university-based, research-based intellectual property, is very important. Nevertheless, in terms of the number of startups, let's say for a million-dollar research funding, we are in the same ballpark as the United States universities,[5] but

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[3] *See, e.g.*, CANADIAN DEP'T OF FINANCE, BUILDING THE FUTURE FOR CANADIANS, BUDGET 1997, CANADA FOUND. FOR INNOVATION (1997), http://www.fin.gc.ca/budget97/innov/innove.pdf (last visited Oct. 11, 2006) (investing $800 million into the newly formed Canada Foundation for Innovation in order to fund research infrastructure at post-secondary educational institutions and research hospitals).

[4] *See, e.g.*, CANADIAN FEDERATION OF BIOLOGICAL SOCIETIES, CREATING A RESEARCH ENVIRONMENT (2000), http://www.cfbs.org/forum_fall2000.html (last visited Oct. 11, 2006) (discussing the extensive infrastructure decay of Canadian government laboratories due to budget cuts in the past decade).

[5] *See*, AUSTRALIAN GOVERNMENT DEPARTMENT OF EDUCATION, SCIENCE AND TRAINING, COUNTRY COMPARISONS OF COMMERCIALISATION, http://www.dest.gov.au/.../policies_issues_

we do have some differences. Universities have the right to have their own policies on who shall own the intellectual property generated from research sponsored with, federal monies.[6] Some universities retain the ownership.[7] Other universities give the ownership to the inventors,[8] and this is very often tied up in collective agreements, faculty contracts, and so on;[9] there are arguments about this.

But the very interesting thing is that there are success stories on both sides, on both approaches. Obviously, the university owned approach is simpler, from the point of view of knowing who the owners are, of the intellectual property, when issues of ownership arise in commercialization.[10] The inventor owned is better, from the point of view of mobilizing the energy and the commitment of the inventor as an entrepreneur, should the odd professor have an entrepreneurial streak.[11] People are very passionate on both sides of this issue. They don't just acknowledge that there are two sides; they believe theirs is the only approach, and they marshal success stories to illustrate that.

So what I thought I would do is to show you one slide – and this will be a busy slide, but the important thing is, it is in your book, and this is useful information. I wanted to underline that, in fact, there are three connections, not one, between the university research in science and engineering and wealth creation in Canada, because coming back to what David said at one point, the name of the game is to make our prosperity sustainable. I mean the country is rich; it needs to become richer given the demographics and all the

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reviews/key_issues/commercialisation/documents/3_x3_rtf.htm (last visited Oct. 11, 2006) (commercialization activity for universities in Canada and the United States per $100 billion vis-à-vis start-up companies is very similar).

[6] *See* Hanis v. Teevan, [1998] 162 D.L.R. (4th) 414, ¶ 49 (Canadian case giving employers, including universities, ownership rights and transfer rights to intellectual property created while employee is under contract or service).

[7] *See, e.g.*, RYERSON UNIVERSITY, INTELLECTUAL PROPERTY GUIDELINES, http://www.ryerson.ca/graduate/policies/documents/IP_Guidelines.pdf (retaining ownership rights when intellectual property is created with extraordinary use of Ryerson facilities and devices) (last visited Oct. 11, 2006) [hereinafter RYERSON I.P. GUIDELINES].

[8] *See, e.g.*, UNIVERSITY OF WATERLOO, POLICY 73: INTELLECTUAL PROPERTY RIGHTS, § III, http://secretariat.uwaterloo.ca/Policies/policy73.htm (last visited Oct. 11, 2006) (stating the University policy that "ownership of rights in intellectual property created in the course of teaching and research activities belong to the creator(s)").

[9] *See, e.g.*, THE UNIVERSITY OF BRITISH COLUMBIA, POLICY NO. 88, at 3-4, http://www.universitycounsel.ubc.ca/policies/policy88.pdf (last visited Oct. 11, 2006) (establishing the procedures and agreements that need to commence before the University will transfer ownership of intellectual property to the creator).

[10] *See, e.g.*, RYERSON I.P. GUIDELINES, *supra* note 7.

[11] *See* Wayne Kondro, *Research Management: Spat over Intellectual Property Threatens Canadian Networks*, SCIENCE, Feb. 14, 1997, at 922,923 (discussing how Universities have too much control over intellectual property which makes it difficult for commercialization and the mobilization of income from the intellectual property).

other things we heard about, so, what I'm going to do is show you the three ways that university research connects with wealth creation. The first one is hiring by industry of people with degrees, who are taught by professors, who themselves are researchers. This means there is some guarantee these graduates will, at least, have heard of some latest developments. The second one is a tremendously important one; it is partnership and university-industry research projects, and I will describe what kind of research that is. And finally, the third one is the commercialization of inventions arising out of basic research.

Let's have a look at these three connections under the categories of the nature of the work done, the time scale for effectiveness, the risk involved, the Government role, and intellectual property implications. But before I move into filling up these boxes, I will simply define categories of research in the agency, which I ran for ten years. We moved away from talking about applied research partly for semantic reasons, but much more so because there were a lot of people around who saw a pot of money labeled research; they were doing something technical and it suddenly became research. Well, if it wasn't quite research, it was applied research, and therefore, that particular label has been devalued to some extent. But basic research has the goal only of discovery, only of answering important, unanswered questions about nature. Project research in university-industry partnerships dealing with projects, is research done to solve a practical problem identified by industry, which can't be solved with existing knowledge. If it could be solved with existing knowledge, it would be solved in-house or sent out to a consultant or a design shop or something. If it can't be solved with existing knowledge, then a university-industry research partnership is set up. The people that are hired, who are taught by active researchers, can do anything industry needs. They are available to function almost immediately depending on the company's training programs. The risk is the usual business risk that is in the company's hands plus the additional risks in the recruiting process: Do you get the right people? Do you miss some of the people you shouldn't have? If the students come from cooperative programs, in fact, the risk is minimized, particularly if they happen to have had employment in that company during their programs. They are known quantities and effective immediately. The Government role is nothing directly, but indirectly it provides money to the professors who are the researchers. The IP implications are all internal to the company.

The nature of the university-industry research partnerships is that if there is a planned product or process innovation that requires new knowledge that can't be generated in-house or doesn't otherwise exist, the research generates it. We are talking now about a time scale of two or three years, possibly longer, because graduate students involved in degrees are participants in this, so, at least, a couple of years. The risk is both the risk of actually getting the science done as hoped for, and, secondly, the risk of being successful in using the results. The Government role in the case of the National Sciences and Engineering Research Council of Canada, ("NSERC"), the Canadian counterpart of the National Science Foundation, ("NSF"), was to provide quality control through peer review.[12] It was a double peer review, a peer review of the science and a peer review of the design of the project, its management structure, reporting structure, budgeting, timelines, milestones, and all of those things. If the project passed the review, the federal agency would put a dollar on the table, and at least a dollar would have to be provided by industry, matching the federal contribution with cash. But in practice, the industrial contribution has been closer to $2 per dollar, and a lot of that second dollar has been what we call auditable in kind assistance.[13] The main IP implication is that Government money will not flow unless an intellectual property agreement has been signed by the partners. The substance of that agreement is between the partners, but there must be an agreement. Finally, the third connection between research and wealth creation: commercializing inventions arising out of basic research, turning an unexpected invention into a product, taking it to market, where it could prove to be some sort of a radical or disruptive or revolutionary innovation, or it could prove to be a dud. This could be a long process.

Remember I am not talking about health research. This is science and engineering, so we are not talking about the many years of clinical trials here, but there could be the process of starting up and trying to feed and help survive a small company if there is no receptor capacity among existing firms. The risk, of course, is both the risk involved in turning the new science into something useful and the risk of the business processes of getting it there. The Government role is quality control through peer review, and the grants, that support the research. And, finally, what I alluded to earlier, the IP ownership rests either with the inventor or the university. NSERC has been applying very rigid standards to a volume of 141 active companies[14] whose history, whose provenance can be traced to a grant for basic research, in a

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[12] *See* NATURAL SCIENCES AND ENGINEERING RESEARCH COUNCIL OF CANADA, DEPARTMENTAL PERFORMANCE REPORT, at 57 (2005), http://www.tbs-sct.gc.ca/rma/dpr1/04-05/NSERC-CRSNG/NSERC-CRSNGd45_e.pdf (last visited Oct. 11, 2006) (detailing the government's role in funding and providing peer review for the various projects).

[13] *See* NATIONAL SCIENCES AND ENGINEERING RESEARCH COUNCIL OF CANADA, PROGRAM GUIDE FOR PROFESSORS 2006, http://www.nserc.ca/professors_e.asp?nav=profnav&lbi=po_a&format=print (last visited Oct. 11, 2006) (explaining how auditable in-kind contributions are handled).

[14] *See,* NATURAL SCIENCES AND ENGINEERING RESEARCH COUNCIL OF CANADA, RESEARCH MEANS BUSINESS (2005), http://www.nserc.gc.ca/research-business/resbus_e.pdf (last visited Oct. 11, 2006) (listing a directory of the 141 companies built on NSERC-supported university research as well as descriptions of such research).

particularly defined discipline, given to a professor some 20, 30 years ago, perhaps.[15] So, for example, one can trace companies that deal with e-commerce, security, and encryption algorithms to work in pure mathematics and number theory supported 30 years ago. This sort of thing can be traced in many fields.

Now, here comes your worst violation of the law of six. This is where your aiding and abetting really gets serious. I am going to start off with a blank screen and turn it into the busiest Power Point Slide you've ever seen. I will show you a model, entirely empirical, of the process by which inventions arising out of basic research in Canadian universities are commercialized on those occasions when a startup company has to be created because there isn't a receptor capacity. This is entirely empirical. It changes every now and then when we learn something new. There is no theory or ideology behind this. So here we have basic research in the universities, and here we have the market, and the whole point is to show how these connect. They don't connect easily. But anyway here come public funds through the agency called NSERC, in the form of discovery grants as they are called, the grants that support basic research.[16] As a result, discoveries and inventions arise from the research process, and the blue arrow, indicates the main output of this, which is codified knowledge, namely research publications. But every now and then, every now and then, unexpectedly, some potential intellectual property may be identified, and by our rules, it has to be disclosed to the institution. But that means that somebody has to recognize it as such. And secondly, somebody has to demonstrate the innovation potential, the suggestion that this new potential intellectual property may lead to a product that fits in the market somewhere where one can presume that a need exists. If that happens, then the intellectual property may be defined and protected. It may be improved in some ways, with some investments in the universities, and then the process of commercialization begins, with the traditional several stages of private investment. Once we get to this point, the invention process is concluded, and everything from here on is the commercialization part of the innovation.

We can make a couple of observations right away. One is that conventional wisdom has it that the amount of private funding required to commercialize, to bring to market an idea, an invention emerging out of basic research is orders of magnitude greater than the cost of doing the research. Of

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[15] *Id.* at 2 (Accutrak Systems Ltd. is a company that began with funding from the NSERC to Dr. Ron Palmer, a professor and researcher of navigational systems).

[16] *See* NATURAL SCIENCES AND ENGINEERING RESEARCH COUNCIL OF CANADA, NSERC RESEARCH GRANTS BECOME NSERC DISCOVERY GRANTS (2002), http://nserc.ca/news/2002/p020607-1.htm (last visited Oct. 11, 2006) (explaining the function of the new discovery grants).

course, you have to realize the limits on that statement. Basic research is a process in which a pyramid of new knowledge is built up through the activities of laboratories around the world, as their findings are communicated openly. Every scientist hopes that the pyramid will reach its apex and burst through the floor in their lab, producing that discovery that will make them famous, and maybe incidentally lead to an invention. This has been going on for centuries. I don't pretend to be able to account for the cost of the pyramid. However, if you compare the cost of the last identifiable project building up to the invention with the cost of the commercialization of that invention, the commercialization is far more costly. We are trying to do some research on this at Ottawa, but we don't expect to find good data easily. I am told that at the low end, in software, this ratio is a couple orders of magnitude, a hundred times or more, and at the high end – and now I am talking pharmaceutical – e.g., in the case of a chemist who has invented a new molecule that may be therapeutic, we are talking about commercialization that costs tens of thousands of times the cost of the research, enormous amounts of money. There is something else that appears here. Risk is a four-letter word, and there is a risk in commercialization: the risk of failure to reach the market and risk of failure in the market, and it is only this private funding that is exposed to that risk. The public funding is exposed to scientific risk, which we try to hold down by the process of peer review that is well established. But in spite of the obstacles, sometimes a successful innovation arises. It creates new value added economic activity, which is a source of wealth creation. It returns money to the public, through the tax system and to the people who invested in commercialization through the direct return on investment. And then, there are two kinds of benefits to society: the benefits of having that service, that good, that new product, or that new process available, which wasn't available before, and, secondly, the economic benefits of jobs that are created and tax revenues and so on.

This is a system that exists and works. But you would never design it this way because the expected outcome and the basis of the funding of the research at the base of the whole thing are the scientific publications. That's what the peer review committees, the panels deciding on funding, work on. Any potential intellectual property is a totally unexpected outcome. Nobody can count on it. Now, recall that the second of the three connections was the purposeful research in universities to solve the practical problem that industry needs help with, and there is a lot of that being done, but we are talking about basic research now. This is what led to penicillin. Interestingly enough, when people rattle off the list of these great inventions that were unexpected discoveries, most of them occurred in industrial labs. I will leave that comment hanging. Anyway, the benefit to the economy that one hopes for is, in fact, a consequence of the unexpected outcome of a system designed to optimize something else. It gets there only with a very large investment, which must be mobilized, and it faces a bottleneck, a very important bottleneck. This is a shortage of people, people who can recognize that something on the shelf of the lab has the potential to become an innovation in the market.

Let me tell you that experimental physicists are notorious for being absolutely ingenious in inventing things to make their experiments work and then putting them on the shelf in dusty boxes once the experiments are done. It takes somebody who has some idea of the market and knows the segments of the market that might correspond to the work to recognize that there is something in that box that could be useful. Now, at other times after some initial discovery, the researchers already begin to think of an application, and I won't go into the details, but I will simply refer you to a book called "Pasteur's Quadrant."[17] I see some nodding around the room, so some people here have read it. It is quite a wonderful book.

And finally, the university that gets involved in this must have the appropriate policies, practices, and goals. So, even though you wouldn't design such a system, it exists. There are some very articulate and successful people, some of them in the private sector, who say don't fiddle with this because if you try to fiddle with this, you will limit the one quality, which is essential in this, and that is the free imagination of the researchers. And you will hear from Bob Crow tomorrow that his colleague Mike Lazaridis, the Blackberry man, is an emotional and passionate advocate of this view. You can't clamp down on the imagination of the researchers. What might these goals and practices of the universities be? Well, the *sine qua non* is the first one. You have to have policies and practices that encourage and provide incentives to the people that do the research and who make the inventions, the graduate students, the professors. Beyond that, there is a set of options. In some institutions, and maybe in many, in the early stages of developing this activity, the hope was that the technology transfer office might break even; that it shouldn't be a drain on other sources and shouldn't be a cost center. What that means in practice is that the target becomes in the range of $2 or $3 million dollars a year, with a staff of a half dozen, and one tries to push the little deals through quickly until the bottom line is made. If that works the university presidents get involved, and the target is raised. Now, it begins to add significantly to university operating funds. That means the targets become a different orders of magnitude. They are in the tens of millions of dollars. One is always looking for the big one, but how many Gatorades are there? Once again, this is not in medical research; this is science and engineering. Universities in many countries, for example the Brits were quite outspoken about this in the report of the Lambert Commission, are accused of overpricing

[17] DONALD E. STOKES, PASTEUR'S QUADRANT: BASIC SCIENCE AND TECHNOLOGICAL INNOVATION (Brookings Institute Press 1997).

their intellectual property, trying to make too much on the deals they close, to the point that this is a problem. It doesn't work; very small percentage of operating funds is there. I think the important one is to enhance wealth creation in the economy, and that means getting the intellectual property out in the most user-friendly and quickest way to those who might use it in the economy.

Finally, let me deal with a question that is often raised in Canada. Why shouldn't Canada have a Bayh-Dole Act? Well, we have to remind ourselves of what the initial conditions were for Bayh-Dole, and that is the federal government of the United States owned the intellectual property arising from research that it supported[18], and it conferred ownership on the universities in return for the obligation to commercial ones.[19] Well, in Canada, since time in memorial, almost since the Flintstones were pushing their stone wheel bicycles around, the universities have had control of the intellectual property. It was up to them to decide or negotiate with their faculty whether it was owned by the inventor or the university, which means that to go with Bayh-Dole in Canada, would in some cases take the intellectual property away from inventors. In practice, in many cases, people meet half way. Inventors who own the IP turn to their universities very often for help in commercializing it, in return for some proportion of the action. If the university owns the IP, the university almost always turns to the inventor for commercial improvement of the intellectual property. So they tend to meet half way. We don't need a national IP policy, since there are many success stories with IP owned by the universities and with IP owned by the inventors as well.

What we need most urgently is faster, more effective transfer of IP and more speed in writing IP agreements. This is particularly necessary in those cases where a network of universities is involved in research projects like our Networks of Centers of Excellence and where occasionally a company has to sign agreements with a half dozen or dozen universities, each of which has different policies and practices and is represented by a different set of lawyers with different priorities in negotiating. This has to be dealt with. We also need more savvy venture capitalists, people who have a science degree and have a finance degree as well. Many venture capitalists say that it is too expensive for them to do the due diligence on small university deals, and so they don't do them. Reducing that cost, to the extent universities can do it would help. Finally, we need greater flexibility on the part of industry in recognizing that academics need to e able to continue working in the same area if they are going to continue to be fruitful and active, so they must have access to whatever prior intellectual property they brought into the arrangement. I am also told by people who do research on this that if you take a half

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18 *See* Bayh-Dole Act, 35 U.S.C. § 200 (1980) (amended 2000).

19 *Id.*

dozen good entrepreneurs and put them in front of one piece of intellectual property, they will find at least a half dozen market opportunities for innovations coming out of that. So, nonexclusive licenses, exclusive in a domain, not exclusive for all domains might be what is needed.

That concludes my overview. Thank you.

PROFESSOR KING: Thank you very much.

UNITED STATES SPEAKER

The Honorable Kelly H. Carnes[‡]

MR. SISTO: Thank you, Tom. I think it was a very thorough presentation, and I like the road map, and we can all now understand the commercialization of university based IP, so when we get that question in the future, we can refer to it. I tried to follow with numbers on the diagram but gave up after about ten.

Our next speaker will be Kelly Carnes, and she will be speaking on U.S. innovation policy: Past, present, and future. She brings a distinguished background with her to this presentation. Currently, she is president of Tech Vision 21, a D.C. based technology-based strategy firm; seems to be well known by many members of the audience, who referred to her upcoming presentation and looking forward to hearing it. She previously served in the White House as a technology policy advisor as well as for four different Secretaries of Commerce, two of whom she served as Assistant Secretary of Commerce. Tech Vision 21 includes global companies, U.S. research universities, foreign governments, science, technology, and nonprofit organizations among their impressive client list. Her presentation, which I had an opportunity to preview, is going to give us a good historical basis for understanding

‡ Kelly Carnes is President and CEO of TechVision21, a Washington, D.C.-based technology strategy firm. TechVision21 clients include global companies, prestigious U.S. research universities, foreign governments and science and technology nonprofit organizations. Previously, Ms. Carnes served in the White House and, later, as a trusted technology policy advisor to four Secretaries of Commerce. As a presidential appointee, Ms. Carnes frequently testified before Congress, represented the United States in negotiations with foreign governments, and served as a liaison to, and advocate for, the technology business community. As Assistant Secretary of Commerce for Technology Policy, Ms. Carnes was as a key point person on numerous high profile issues affecting technology businesses. Ms. Carnes has also served on a National Governors' Association Commission on Technology and Adult Education, the Steering Committee for the Commission on the Advancement of Women and Minorities in Science, Engineering and Technology (the "Morella Commission") and review panels for the National Science Foundation's Small Business Innovation Research program.