CANADIAN SCIENCE POLICY

CONFERENCE REPORT 2009

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Canadian Science Policy Conference

October 28-30, 2009

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INTRODUCTION

Dr. Mehrdad Hariri
CSPC 2009 Chair

Dear CSPC participants;

It is with great pleasure that I present the book of proceedings of the Canadian Science Policy Conference (CSPC) 2009. This book, courtesy of The Mark, the CSPC's media collaborator, features summaries of keynote addresses, plenary sessions, and concurrent panel discussions. It is a record of the invaluable ideas tabled by participants on the most salient issues of Canadian science and technology policy, as well as a guide for follow-up steps over the course of next year.

The CSPC 2009 was a great success in bringing together individuals of the highest calibre. This event was the largest gathering of its kind to date, creating an unprecedented level of excitement on the subject. More than 400 delegates from a diversity of sectors and disciplines attended the conference and over 25 organizations lent their support in different forms. In 13 panels, a wide range of science policy issues were discussed and debated. As the Honourable Gary Goodyear, the Federal Minister of State for Science and Technology, mentioned in his keynote address, the conference was "ground-breaking" and shows a "… move towards creating a national science policy network that includes business, academia, government, and the non-profit sector, and promoting the next generation of researchers and innovators."

CSPC 2009 was a grassroots effort, driven by young people, which received the support and endorsement of key players in the science policy field, and was met with an extraordinary level of enthusiasm and excitement. Of all the feedback we received from individuals and organizations, one message stood out: Canada urgently needed a non-partisan inclusive forum to discuss science policy issues and CSPC 2009 filled that void. Now we must remain faithful to the shared goal of continuing such a forum. I am certain that Canada's potential in science is far greater than what has been realized to date; with greater support, CSPC can become the foremost conference on science and policy issues in Canada and can help to unleash our country's potential in these fields.

We were also able to bring science policy issues to a general audience. The volume of knowledge and insights generated as a result of the conference has been extraordinary. The Mark has created a special section on their website dedicated to science policy, and featuring contributions from several high-profile conference speakers—from university presidents to government advisors. In collaboration with The Mark, we are in the process of finalizing a documentary that includes 35 interviews with prominent members of the science policy community. Similarly, in the aftermath of the conference, The Hill Times published a special issue on innovation, with several pieces contributed by conference speakers.

"More than 400 delegates from a diversity of sectors and disciplines attended the conference and over 25 organizations lent their support in different forms."

The Globe and Mail, TVO, Biotechnology Focus, University Affairs, are among the other media outlets that have covered the conference.

The number and quality of ideas generated during CSPC 2009 was enormous. I was delighted to learn that a number of those ideas are already being pursued. At the same time, the organizers of CSPC are currently analysing various plans and follow-up actions, some of which include:

1. The establishment of a Canadian Science Policy Network, to act as a central clearinghouse for science policy research and people. Forging stronger ties between various science policy stakeholders was one of the main objectives of the conference. A dynamic network is a step toward achieving that goal. A website, newsletter, on-line discussion forum, and a periodic opinion section are the essential elements of such a network. Yet the most important task at this stage will be organizing the Canadian Science Policy Conference on an annual basis. As Preston Manning noted in his keynote speech, the conference should take one lesson and develop it. In my opinion, institutionalizing the CSPC is that key lesson.

2. Support the ongoing efforts to establish a Research Institute on Science Policy. We hope that the CSPC can host the discussion, and help finalize and promote the establishment of such an entity.
From these initiatives many other ideas will emerge.

However, our success depends entirely on the continued support of Canada's main science policy institutions—government, granting agencies, universities, research institutes and the private sector. Our capacity to expand is proportional to the support we receive.

"Canada's prosperity and competitiveness very much depend on our scientific research."

Finally, Canada's prosperity and competitiveness very much depend on our scientific research. The twenty-first century is well underway, and science policy needs new and sophisticated organizations to address its needs. Many new competitors in science and technology have emerged on several continents: China, India and Brazil are investing tremendously in their R&D infrastructures; Sweden, Switzerland, Finland, Singapore, South Korea, and the U.S. are leading globally in innovation. Canada lags behind other nations when it comes to science policy infrastructure, and greater focus in this area is necessary if Canada wishes to remain competitive with other nations. Better communication among stakeholders and especially political institutions and the scientific community has never been as important as it is today.

The Government needs to understand the importance of involving the scientific community in the decision-making process. At the same time, the scientific community should begin a concerted effort to organize itself, and to develop its advocacy capacity. The private sector should systematically get involved in commercialization and increase its R&D spending in order to catch up with Canada's global competitors. However, without proper incentives from government and from the scientific community, this involvement will not be as efficient.
With all the issues that our science policy community faces today, we believe that a forum in which we can network and discuss, build trust, and plan for the next steps is truly crucial. This indeed is the promise of building an annual science policy forum.

I look forward to discussing these issues with all of you in the upcoming months. ■

KEYNOTE: HON. JOHN MILLOY, MPP

Ontario Minister of Research and Innovation

Chair Dr. Mehrdad Hariri, postdoctoral fellow of the McLaughlin-Torman Centre for Global Health, opened the 2009 Canadian Science Policy Conference by expressing his conviction that science policy should be at the centre of Canada's foreign and domestic policy because the prosperity, health, standard of living, and global competitiveness of the country are linked to the strength of our science research and innovation. He argued that we need sound government policies and the current status of these policies is sub-optimal. He said we need better channels of communication between the scientific community and policy makers and expressed his hope that the conference would bring much needed attention to this problem and lay the foundation for an ongoing discussion.

The Hon. John Milloy, the Ontario minister of Research and Innovation and minister of Training, Colleges and Universities said that he considered Ontario to be a pioneer in science policy with the creation of Canada's only standalone ministry of research and innovation in 2005. The impetus for the ministry came from the realization that the province was going through an economic transformation and needed to spur a culture of innovation. A road map was created and supported with funding that focused on three key areas for the province: health sciences, the digital economy, and green technology. Milloy then spoke of a need to collaborate with partners outside of the province, citing the first provincial-territorial meeting on innovation held in Stratford last year, with the purpose of building a national strategy. Milloy expressed his hope that the federal government would join the next meeting—to be held in Edmonton—to help move the dialogue forward. The minister concluded by saying that, "There is much agreement and consensus among us on the importance and urgency to move forward on a national innovation agenda. It will take vision, it will take policy leadership, and it will take political leadership; it will take a considerable amount of effort, but I think we all know that it is the right thing to do." ■

KEYNOTE: DR. BRUCE ALBERTS

Editor-in-Chief, Science Magazine

Dr. Christopher Paige, vice president of Research at the University Health Network, was then invited to the stage to deliver a short introduction for the keynote speaker of the evening, Dr. Bruce Alberts, the editor-in-chief of *Science* magazine and former president of the U.S. National Academy of Sciences (NAS). Alberts discussed the structure and role of the NAS. The NAS was created by Abraham Lincoln as an honorary society of the nation's best scientist, with a charter that required it to investigate and report to the U.S. government on questions regarding science and technology. Alberts pointed out that the most important aspect of the NAS was its independence. The government will often pay for the cost of a study that it requests, Alberts said, but they have no influence over the results of the findings; unlike many other organizations and think tanks, the government is not allowed an opportunity to see NAS reports until they are finished and publicly released —often a source of conflicts with agencies when they do not like the organization's findings.

Scientific information is crucial for policymakers to understand the long-term consequences of their decisions.

NAS reports come in two classes: "science for policy" or "policy for science". Alberts gave a number of examples of the first type, including one report on the health effects of low levels of arsenic in drinking water and another on the causes of global climate change. Alberts argued that scientific judgements of this type are crucial for policy makers, because scientific understandings of the natural world will in many cases allow scientists to predict the effects of current actions on the future. He said that for governments to make wise long-term judgements they need to know the science that underlies their policy-making. Alberts then talked about the usefulness of the web

in making scientific information accessible to the public and explained that more than 4000 NAS reports are completely free as PDFs for 146 developing nations. Concerning policy for science, Alberts identified three types of reports: Those that resolve disputes in the scientific community —for example, the report on sequencing the human genome; those that attempt to resolve societal concerns—for example, the reports on human cloning and the use of stem cells; and, those that promote a new scientific direction.

Developing countries need more of the creativity, rationality, openness, and tolerance inherent in science.

Alberts then discussed what this means in practice. The critical lesson Alberts said he learned from his years in Washington is that science is much more important than even many scientists think. Nations will need more of the creativity, rationality, openness, and tolerance that is inherent to science if they want to develop effectively. Alberts suggested three potential strategies to help spread science through the global society: First, there is a need for more people trained in science to join other professions in order to serve as the "adaptors" needed to connect these professions to the scientific community —"What I came to realize is that our society is made up of a series of different tribes. It's almost like anthropology," said Alberts, about the different professional cultures in America and the difficulty of communicating between them. Second, he suggested a focus on science education involving active inquiry at all levels. There is a need, Alberts said, to reach out to young learners to make science much more appealing and productive for them. Finally, Alberts said, the scientific community needs to become better organized. He noted the creation of several new science and technology institutions working towards this goal, including the InterAcademy Panel in Trieste and the InterAcademy Council in Amsterdam.

Alberts concluded by saying, "The fact is that scientists everywhere can agree on almost everything because we share a common culture that bases its way of thinking on evidence, analysis, and rationality; for this reason, scientists can really be great ambassadors across the world."

During the question and answer period, one participant asked Alberts what young people can do to become involved in the scientific community that is dominated by older figures. Alberts pointed out that you need to be successful to have influence, but that in several countries, the senior academy has formed a new academy to empower younger scientists and prepare them for future leadership positions. In answer to another question, Alberts discussed the importance of science to the Government of China, which has recently been making huge investments in science at universities and research institutes compared to other nations. Alberts speculated on the potential for productive diplomacy between China and the West through their scientific communities. In response to a third question from Katie Plaisance, from the Centre for Knowledge Integration at the University of Waterloo, about the potential for non-scientists to act as communicators between the scientific community and others, Alberts spoke of the need for all types of people to help spread science, and the importance of "breaking down ivory towers" to connect academia to the rest of the world.

In response to a third question from Katie Plaisance, from the Centre for Knowledge Integration at the University of Waterloo, about the potential for non-scientists to act as communicators between the scientific community and others, Alberts spoke of the need for all types of people to help spread science, and the importance of "breaking down ivory towers" to connect academia to the rest of the world. ■

KEYNOTE: PRESTON MANNING, CC

President, Manning Centre for Building Democracy

Keynote speaker for the second day of the 2009 Canadian Science Policy Conference, Preston Manning, was introduced as having a "unique and unbeatable position" on science policy. Manning, founder of both the Reform Party of Canada and the Canadian Reform Conservative Alliance, began by identifying three challenges to Canadian science policy: first, the need to increase the number and quality of science receptive people at the political level; second, the need to raise the strategic and financial commitment to research and development in the private sector; and third, the need to bridge the communication gap between the scientific community and the political community.

In order to get a better response to scientific proposals at the political level, Manning said, there needs to be politicians and senior staff with a background and interest in science, something Canada is severely lacking at the moment. By Manning's count, there are only eight members of parliament with a "real" science background and the situation is even worse at the provincial level. "When scientific issues come up in caucus, who is the champion?" Manning asked. This lack of scientific knowledge is reflected in the nominal attention given to science in political party platforms and infrequent reference to science in political debates, despite the importance of many scientific issues, including health, the environment, and economic competitiveness. In order to deal with this issue, Manning gave two suggestions: First, encourage the political parties to recruit more science-oriented candidates for elections. Scientists could create a list of potential nominees to give to parties; second, establish a parliamentary office of science and technology, similar to what the British have had for a number of years.

Manning then called attention to the decline in spending on research and development by Canadian companies. The challenge in dealing with this, he noted, is that Canadian businesses have been slightly more profitable than their American counterparts over the last four decades, despite the relatively low levels of productivity, so there is little incentive for business to increase their research and development spending. "You won't change their behaviour simply by preaching to them," Manning said; to change these incentives and conditions requires a change

in public policy. Manning suggested a strong, private-sector based, not-for-profit think tank/"do tank" to focus on such problems. He noted that many other sectors have such think tanks, so why not science policy? Manning's proposal, called the Centre for Innovation and Prosperity, would perform four functions: One, push for more research and development investment; two, push Canadian businesses to adopt complementary innovation strategies; three, follow up on previously made recommendations that have been mostly forgotten about; and four, provide services to address the communications gap between the scientific, business, and policy communities. Manning stressed the importance of private sector funding for such an organization so that asking for money does not overshadow the policy recommendations when dealing with the government.

Manning went on to discuss the communication gap between scientists and politicians. The scientific community is beginning to appreciate, Manning said, the extent to which communications utterly dominates the political arena and mindset. If a political actor cannot see how to communicate a position to the public in 90 seconds or less, he said, that position is in trouble—no matter its merits; the politician has to be able to easily explain any government proposal to a reporter or the participants at a town hall meeting. Politicians, Manning explained, consider their audience first: What do they want? What are the competing interests? What is the context? Only after they figure out their audience do they think about how to approach them to get what they want. If scientists want to effectively communicate with the political community, they must do the same.

This is why it is important to secure the services of people who understand the political mindset and can help scientists communicate in the political arena.

Manning concluded by stressing the importance of actually responding to challenges. "One of my fears is that we Canadians are coming to what might be called 'discussionitis,'" he said, referring to the "endless analysis, preparation of pre-convention papers, post-convention papers, [and] the framing of resolutions" in place of action or pressuring others to act, to further science policy. Manning ended by suggesting that the conference should take its one best idea and develop an action plan to secure its implementation, and keep pushing until it is implemented or rejected; either way, it would be a valuable lesson for the scientific community.

During the question and answer period, Robert Mann, president of the Canadian Association of Physicists (CAP), asked if the lack of scientifically oriented politicians and the communication gap were as big of a problem in other countries and why. Manning answered that other countries definitely had more politicians with a science background. He could not say why, just that science seems to be excluded from the political culture in Canada. Alex Bielak of Environment Canada asked what scientists could do better in presenting to politicians. Manning answered that arguments need to be framed in the context of the day, citing an example of a meeting held at the start of the economic downturn where the presenters did not think to connect the science with economic recovery. Diane de Kerckhove, an assistant professor of Physics at the University of Guelph asked how scientists could be recruited into politics when the perception of politics is very negative. Manning answered that the level of debate must be raised, perhaps by appealing to the nobler elements of politics. He also noted that in the past, parliament treated certain areas like foreign policy as nonpartisan. Perhaps science could be treated similarly. ■

KEYNOTE: HON. GARY GOODYEAR, MP

Minister of State, Science and Technology

Keynote speaker the Hon. Gary Goodyear began his address by noting that October 30, 2009, marked the first anniversary of his appointment as Minister of State for Science and Technology, and adding that he feels privileged "to represent the interests of people like you." For Goodyear, this conference represented a "ground-breaking" move towards creating a national science policy network that includes business, academia, government, and the non-profit sector, and promoting "the next generation of researchers and innovators."

Goodyear noted Canada's history of scientific achievement, whose hallmarks include: standard time, developed by Sir Sandford Fleming; kerosene, first refined by Abraham Gessner; and insulin, developed by Frederick Banting. Their legacy carries forward today—this year, Dr. Willard Boyle of Nova Scotia won the Nobel Prize for physics and, also this year, Toronto once again hosted the Gairdner awards for biomedical research, which are known and respected worldwide.

Goodyear emphasized the Conservative government's commitment to integrating scientific and technical knowledge into wider Canadian society, citing the government's 2007 launch of a Science and Technology strategy, and their release of a progress report on it earlier this year. He also highlighted the importance of building a strong sci-tech culture in Canada by helping Canadians better understand how science, technology, and innovation drive our economy. This is necessary, he said, to encourage the next generation of Canadians to pursue knowledge-based careers.

Goodyear added that science policy needs to be "a two-way street." Governments must find the best framework under which scientists can pursue excellence and scientists must provide government with advice on how best to build that framework. Goodyear highlighted his government's commitment to building that framework, noting that science and technology spending has increased every single year since the Harper government came to office; in the 2007-08 budget, it increased to $10.2 billion and the latest figures indicate it will reach $10.7 billion this year; since 2006, the Canadian government has allocated $7 billion in new money for science and

technology innovations through "major multi-year investments."

Goodyear noted that, in the past, recessions have forced Ottawa to cut science and technology spending. But the 2008-09 budget dedicated $5 billion in new investment toward the sectors where a lot of research and development takes place, with an aim to stimulate the economy and making businesses more innovative, and more competitive.

The federal government has also invested $2 billion in infrastructure for post-secondary institutions and between 2006 and 2008 increased funding for the Social Sciences and Humanities Research Council, the National Science and Engineering Council, and the Canadian Institute for Health Research by between 13-28 per cent each. These funding increases are "cumulative, permanent, and ongoing." Goodyear went on to note the federal government's commitment to building a Canadian "people advantage." In 2008, it set up the Vanier Scholarship program, which is one of over seven thousand different scholarships offered by the federal government, which together retain Canada's best minds, and persuade the world's best minds to come to Canada.

Ottawa has also moved to strengthen the partnerships between the public, private, and academic sectors through its Networks of Centres of Excellence, including business-led networks of centres of excellence, and centres of excellence for commercialization and research. These commitments, Goodyear added, are multifaceted and multi-year, funding equipment, facilities, people, discoveries, products, new markets, jobs, and better quality of life.

The 2009 Science and Technology strategy report makes clear that investments in basic discovery must continue, and Goodyear pledged that Canada "will remain among the very best countries in the world for scientists and researchers to pursue their discoveries." At same time, the federal government is improving its capacity to bring research to market, by creating a business environment that rewards success and removes unnecessary red tape. Goodyear said this was what the federal government had in mind when it cut taxes, and introduced the Scientific Research and Experimental Development tax credit and capital cost allowances for businesses.

Goodyear pointed to two reports that suggest Canadian innovation is lagging. While the minister called this "a decades-old problem," he said recent reports on the problem remain a "wake-up call for... anyone concerned with science and technology in this country." The Council of Canadian Academics report *Innovation and Business Strategy: Why Canada Falls Short* argues that the future of Canadian productivity is tied directly to the business community's capacity to innovate and use innovation as a competitive strategy. Minister Goodyear added that competition from Brazil, India, and China creates new challenges for Canada and demand that we be at the "top of our game." The Science, Technology, and Innovation Council's *2008 State of the Nation* report indicates that while Canada is doing well and improving, other countries are improving as well—and often, faster.

Goodyear called on Canadian companies to take advantage of Canada's existing foundation of science and technology excellence by investing in research and development in Canada: "The private sector must do research; they must do more development; and, they must be more innovative." Goodyear concluded by calling on scientists to contact him to let him know "how we [the federal government] can work with you, how we can help you, how you can help us help you," with the goal of building a science policy "vision . . . that we can all understand, all embrace, and all rally around." ■

From L-R: Dr. Peter Singer, Dr. Christopher Paige, Dr. Alain Beaudet, Dr. Heather Monroe-Blum.

CANADA'S SCIENCE AND TECHNOLOGY STRATEGY

PANELISTS

Dr. Alain Baudet
President, Canadian Institutes of Health Research

Dr. Heather Monroe-Blum
Principal, McGill University

Dr. Christopher Paige
Vice-President, Research, University Health Network

Dr. Peter Singer
Director, McLaughlin-Rotman Centre for Global Health

MODERATOR: Dr. Kamiel Gabriel
Assistant Deputy Minister, Ontario Ministry of Research and Innovation

Moderator Dr. Kamiel Gabriel, the founding Associate Provost of Research at the University of Ontario Institute of Technology (UOIT), began the opening plenary session on Canada's national science and technology strategies by looking at the role of the provincial governments in determining science policy and how the scientific community can support the federal science and technology strategy introduced in 2007. He laid out where Canada stands in the world and cited the World Economic Forum's Global Competitiveness Report 2009-2010 that ranked Canada as the ninth most competitive economy in the world. This position, Gabriel said, depends on the countries success in two key areas: business sophistication and innovation. According to another report, by the Canadian Council of Academics, however, there are gaps in the Canadian business community. These challenges, Gabriel said, must be dealt with "head-on."

Dr. Heather Monroe-Blum, principal and vice-chancellor of McGill University, argued that Canada lacks a national strategy. "At the end of the day, what we need is some sort of coherent vision across the country that will allow us not to hold hands and do everything in unison, but to leverage our assets successfully," she said. Munroe-Blum listed some of these assets, including: a high quality of life, openness, diversity, tolerance, and a relatively well-educated population. Challenges facing the country, Munroe-Blum said, include its low level of productivity and the difficulty of creating synergy across Canada's large land mass with a relatively small population. The economic downturn, she suggested, could be an opportunity to position the country for success moving forward, but that success is impossible if we do not benchmark ourselves against collaborators and competitors, and do not promote the regions and individuals that can compete at an international level. If Canada wants to be a leader on the world stage, Munroe-Blum said, we must understand the world. This is

where the multiculturalism of the country, as well as those trained in the social sciences and humanities, will be great assets.

Dr. Alain Beaudet, president of the Canadian Institutes of Health Research (CIHR), spoke about the state of health research in Canada. He pointed out that the country was among the top OECD countries in terms of impact of publications in the health sector, among the top industrial countries in terms of public investment in science, and had a high quality of training. Beaudet also noted that health research has an extremely high return on investment. He then listed a number of shortcomings, including a lack of Nobel Prize winners and a lack of PhDs. To improve, Beaudet said, there should be a focus on basic science, support for the country's best to make them competitive at the international level, more government investment, a proper balance between investment in capital, infrastructure, personnel, and operations, and more support for multi-disciplinary science. Beaudet also said that Canada needs to take a leadership role in big international projects.

Dr. Christopher Paige, vice-president of Research at the University Health Network, talked about hospitals, which he described as "icons of some of humankind's highest aspirations" for health, and a society wealthy enough to afford healthcare for everybody. Paige pointed out how hospitals are both centres of research and economic drivers for communities, and so deserve considerable attention from policy makers. Hospitals, Paige said, still struggle to find funding for research and development, which are at the source of innovation, because governments are too concerned with cost containment. Public policy, Paige argued, should promote mandates for innovation.

Dr. Peter Singer, director at the McLaughlin-Rotman Centre for Global Health, talked about how science policy should be projected internationally to deal with global challenges with a focus on the developing world. "It's time to propose a new vision," Singer said. "One that can contribute to creating a better and safer world." He suggested that this not just a humanitarian issue but a commercial one as well. As a small market dependent on the U.S., Canada needs to look outward towards emerging markets like China and India. To do this, Singer said, the country has to take advantage of its immigrant population to build ties with their countries of origin. He listed five reasons to help foster innovation in the developing world: One, to correct the disparities in health, energy, and food that afflict 5 billion people in the world; two, in solving problems in the developing world, we can learn how to solve problems in Canadian communities; three, to reinforce trade relationships in innovative sectors of the economy; four; to help countries develop; and five, to help foster diplomacy. Singer concluded by saying this was "just the kind of marriage between science and public policy that this conference envisions, and that these times demand."

During the question and answer period, Brian Underdown of Lumira Capital asked about the difference between excellence and innovation, and which we should be funding more. Beaudet answered that we need to fund both, as there is no innovation without excellence. He added that to support innovation, we need to take more risks and break down barriers between disciplines. Diane de Kerckhove, an assistant professor of Physics at the University of Guelph, asked how the current science curriculum, which has very little cross-over, should be changed to train scientists to become more involved in other sectors. Munroe-Blum agreed that boundaries needed to be taken down to allow scientists to follow their curiosity. Beaudet suggested putting an emphasis on training abroad to expose students to what is happening in other countries. ■

From L-R: Mark Lievonen, Dr. Peter Hackett, Dr. Suzanne Fortier, Dr. Peter Nicholson

THE CANADIAN ECONOMY

From Resource-Based to Knowledge-Driven

PANELISTS

Dr. Suzanne Fortier
President, Natural Sciences and Engineering Research Council

Dr. Peter Hackett
Executive Professor, University of Alberta School of Business

Mark Lievonen
President, Sanofi Pasteur Ltd.

Dr. Peter Nicholson
President, Council of Canadian Academies

MODERATOR: Dr. Chad Gaffield
President, Social Sciences and Humanities Research Council

Moderator Dr. Chad Gaffield, president of the Social Sciences and Humanities Research Council (SSHRC) began the second plenary session on the Canadian economy from resource-based to knowledge driven with the suggestion that "we are on the verge of a new way of thinking about Canadian success thus far, and how we might move forward." He said that throughout the history of the country, there has been a steady investment in human capital—one that should be increased for a new era that places even more emphasis on people power. Gaffield suggested that we have been moving from a simplistic model of the linear transfer of knowledge to a more complex multi-dimensional system of transferring knowledge and sharing innovation. Economic growth is now seen as growing from and interacting with social, cultural, and political strengths to create a stronger society. There is a need, Gaffield said, for different sectors to work together "shoulder to shoulder" to meet the complex challenges facing us.

Dr. Peter Nicholson, president of the Council of Canadian Academies (CCA), discussed the importance of business innovation to the knowledge economy. He first asked why Canadian businesses are not more committed to innovation strategies. To answer this, Nicholson pointed to three factors: first, the small and fragmented nature of the Canadian market; second, too many parts of the economy occupy upstream roles in North American value chains; and, third, Canadian corporate profits have actually been higher than their U.S. counterparts most of the time, meaning there is little incentive to change.

Nicholson said that the conditions facing Canadian businesses were changing due to: less assured access to the American market, new opportunities as well as greater competition from emerging markets, new environmental challenges in resource development, and the more global mindset

of new Canadian business leaders. To foster more innovation, Nicholson said that we need to invest more in technology (especially ICTs), focus more on downstream export markets, promote promising start-ups, gain a better understanding of the innovation process, and deepen policy-makers' knowledge of different sectors.

"We've had report after report in the last ten years that have told us the same thing: we need to step it up when it comes to innovation."

- Dr. Suzanne Fortier

Dr. Suzanne Fortier, president of the Natural Sciences and Engineering Research Council of Canada (NSERC), argued that, while Canada has a good system for science, technology, and innovation, we need to be better connected. "We've had report after report in the last ten years that have told us the same thing: we need to step it up when it comes to innovation. Fortier suggested three things we need to do to foster more partnerships for innovation: first, we need to build sustainable bridges between actors in the private sector and universities; second, we need to remove "unnecessary speed bumps" that slow down actors; and third, we need to "build high rises" in areas of excellence so that actors can seize opportunities. Fortier added that it was important to have research and development-driven innovation in all sectors —including natural resources—and to reduce costs and increase affordability in order to compete with emerging markets.

Dr. Peter Hackett, executive professor in the School of Business at the University of Alberta, argued that people, not institutions, are innovative, and that institutions need to follow people in order to remain innovative. Using the examples of skateboarders and surfers, he said that risk-takers spark technological innovation by constantly pushing the boundaries of what is possible and that whole new industrial sectors are created without the need for government intervention. Hackett said that the younger generation needs to challenge old rules and ask questions about the status quo: "I want you to think deeply about these things, go to a root cause analysis," he said. "If you do

that, we might have the chance to create a growth agenda, building a better tomorrow in Canada rather than settling for the incremental agenda of building a better yesterday." New thinking is required if Canada is to move to a creative economy from an extractive economy. Hackett warned that the extractive economy, while lucrative, might starve the creative economy from opportunity and aspiration, ultimately hurting Canada's competitiveness. The extractive economy, he said, has shaped the mindset of our institutions and the new generation needs to move beyond it. Canada has grown rich from its natural resources and will likely remain rich but it has to live as a rich society if it is to attract and retain the people who will build the creative economy. Rich societies live rich by making large investments in the education of their people and by taking on issues of global human development and thereby they attract innovators to them. Canada does not lead in these matters. In fact, Canada trails all developed countries in its production of PhD graduates and Canada's investments in global human development fall far short of the aspirations of Canadians. The creative economy will only emerge if these root cause deficiencies are addressed. And if government has any role at all in speeding the creative economy that role must lie in support of these two

Dr. Peter Hackett

agendas.

Mark Lievonen, president of Sanofi Pasteur Limited, spoke about the history of his company, Sanofi Pasteur, which has created vaccines for many diseases, including diphtheria, polio, smallpox, and whooping cough. Lievonen noted the high level of investment that the company has made, including a large amount in research and development.

From this, Lievonen drew a number of conclusions: first, success begets success as the company tries to build on its accomplishments; second, success in Canada can lead to success around the world; and third, a company needs to be able to reinvent itself to adapt to changing conditions.

Lievonen stressed the importance of innovation and engaging with the public to make it understand this. He spoke of the need to redefine commercialization as a long-term goal and recognize that health care spending also creates wealth. Lievonen concluded by saying that all levels of government should have a common view of where the country needs to go in terms of innovation and the knowledge economy.

During the question and answer period, Ron Freedman of The Impact Group noted that 68 per cent of the economy is in the service industry, which has been resistant to improvements in productivity. He asked how to best improve productivity in that sector.

Dr. Nicholson agreed with Freedman and suggested that much of the unproductiveness in the service sector was due to a lack of investment in information communication technology. Martin Taylor of Ocean Networks Canada asked about the structure of government necessary to fulfill the aspirations of Canada in a globalized economy. Fortier answered by stressing the importance of education in science and technology. ■

IMPLEMENTING SCIENCE KNOWLEDGE IN DECISION-MAKING

Lessons Learned and New Models

PANELISTS

Eleanor Fast
Program Director, Council of Canadian Academies

Jeff Kinder
Manager, Science and Technology Strategy, Natural Resources Canada

Bryn Lander
PhD student, University of British Columbia

Dr. John Leggat
Associate Consultant, CFN Consultants

Dr. Ann McMillan
Department of Fisheries and Oceans Canada

MODERATOR: Adam Holbrook
Adjunct Professor, Simon Fraser University

Moderator Adam Holbrook, an adjunct professor at Simon Fraser University, began the panel presentation on implementing scientific knowledge in the decision-making process by asking each participant to propose one question for their co-panelists at the end of their presentations.

Dr. John Leggat, an associate consultant with CFN Consultants began the discussion by talking about the relationship between science and decision-making. He identified a number of areas where scientific advice can significantly contribute to decision making, including risk assessment, defining what realistically can be done, defining what is known, and giving advice on how to deal with hard problems. Leggat said that to fully connect with any organization—be it business or government—scientists need to understand the motivations of the organization. He pointed out that there is often a mismatch between the two groups. "We, as scientists, tend to go very deep and not very broad. The decision maker tends to be very broad and not very deep," Leggat said. One way of dealing with this problem, he said, is to do more operational research. He suggested the need for networks that involve scientists, decision makers, and the people in between. Leggat's question for the group was how to organize such a network.

Bryn Lander, a PhD student at the University of British Columbia, talked about how to

motivate scientists who work at universities to pursue non-research activities. She suggested expanding what is defined as translational activities and reward involvement in them. This can be done, Lander said, through funding agencies. Many of these agencies, however, have guidelines in their policies that ask scientists to show how their research has potential economic benefits. The focus of government policy, she said, is now on economic benefits over social benefits. "Scientists need to find a way to look at social benefits as well as economic benefits, she said, and the funding needs to reflect this. Lander's question for the group was what measures can be developed for a broader view of what is translational.

Dr. Ann McMillan of the Department of Fisheries and Oceans Canada (DFO) discussed science assessment. It is important, McMillan argued, that the questions in scientific assessments be developed by scientists, policy makers, and other stakeholders together. The assessment should be done by experts in the field and deliver advice for policy makers. McMillan said that science assessments have been successful in organizing the scientific community and addressing important policy concerns, but they do not have as much impact on policy decisions as they ought to have. She suggested that over the last

decade, science processes have been modernized to be more responsive to policy needs, but the policy side within Canada requires modernization to make it more receptive to science. Science assessments are most useful when they feed into defined policy processes. Her question for the group was how this best could be done within Canada.

Jeff Kinder of Natural Resources Canada and a PhD candidate at Carleton University discussed the science advisory mechanisms that exist in Canada. He first gave a brief history of major science advisory bodies in Canada. He then noted the two strands of science policy—science for policy and policy for science—in order to identify the focus of different organizations. Under science for policy, various groups give advice depending on the sector, while organizations like the Council of Canadian Academies (CCA) provide assessments. Under policy for science, organizations like the Science, Technology and Innovation Council (STIC) give advice, but there is a lack of organizations providing assessments. Kinder suggested Canada needs to fill this gap with some sort of organization, as the British and Americans have. "There's room for analysis... that informs public debate and parliamentarians," Kinder said. His question for the group was what is missing from the Canadian scientific landscape.

Dr. John Leggat

Eleanor Fast, program director at CCA, gave an overview of the CCA. She argued that independence and quality are vital for scientific advice, and that these elements are at the core of the CCA model. She noted that there has been a change in the way the public accesses and processes information, from depth to speed, from elite to more public "wiki" models, and from old to new media. The CCA, however, remains committed to standards of quality, Fast said. Most assessments take between 12 and 24 months, and all evidence, including any public input, is filtered through a multi-disciplinary group of experts. Her question for the group was whether there is a model that combines the values of independence and quality with speed and real public engagement.

In response to Kinder's question, Leggat said that many people on the policy side do not have the time to read long scientific assessments. Those who have a stake in the issue must explain the position to policy makers. McMillan said that various government agencies are stepping into that role.

In response to Leggat's question, Kinder said that the science and policy communities function in such different ways that it is necessary to have people who understand both sides act as a bridge. Holbrook then asked the panel to speculate on the state of science policy 25 years from now. McMillan suggested giving someone the responsibility to do just that.

During the question and answer period, one questioner from the audience asked about how best to situate science to respond quickly to the issues of the day. Leggat answered by saying that there was difficulty in trying to find a single answer on issues for which there might be disagreement in the scientific community. Alastair McIver of Atomic Energy of Canada responded to the question posed by Lander by saying that the government needs to create mandates for non-economic research. ■

WHO SPEAKS FOR SCIENCE?

Stakeholder Communication in Canada's Scientific Community

PANELISTS

Dr. Deb de Bruijn
Executive Director, Canadian Research Knowledge Network

Dr. Rees Kassen
University Research Chair, Experimental Evolution, University of Ottawa

Dr. Robert Mann
President, Canadian Association of Physicists

Dr. Reinhart Reithmeier
Chair, Biochemistry Department, University of Toronto

MODERATOR: Kevin Shortt
President , Canadian Space Society

Kevin Shortt, president of Canadian Space Society, moderated the panel presentation on who speaks for science and stakeholder communication in the Canadian scientific community.

Dr. Rees Kassen, University Research Chair in Experimental Evolution at the University of Ottawa and chair of the Partnership Group for Science and Engineering (PAGSE), began by presenting PAGSE's communication strategy, which, since 1995, has aimed to move past the myriad voices of the scientific community and present the consensus opinion of scientists and engineers to the federal government. "We are not a lobby group. We do not ask for money and we do not advocate on behalf of any particular organization," said Kassen. One way they pursue their mandate is through PAGSE's flagship program, "Bacon and Eggheads," a breakfast meeting series on Parliament Hill featuring presentations by top scientists—like Jeffrey Dahn, Dalhousie University on fuel cells—targeting parliamentarians. Four hundred and sixty-seven MPs and 76 senators have attended these breakfasts, with coverage from CBC and Reuters. They also deliver briefs to House and Senate Committees and meet decision makers. PAGSE has executive monthly meetings to decide policy directions. Some PAGSE recommendations have been adopted by the House of Commons, which PAGSE considers an indicator of success. Kassen said PAGSE's positions matter because it is not perceived as a lobby group and represents a consensus opinion.

Deb de Bruijn, executive director of the Canadian Research Knowledge Network (CRKN), gave an overview of the CRKN's goal, design, and operation: "CRKN coordinates and makes available high cost, high impact research papers, books, and other content digitally to 73 Canadian post-secondary institutes to build Canada's capacity for research and innovation," she said. The guiding philosophy is that digital

content available for research should be considered infrastructure; it needs long-term commitment and investment, it's designed with public policy in mind, and, therefore, should be eligible for infrastructure investment. CRKN spends $95 million annually on content licenses with a near 50/50 split between sciences and science and technology. DeBruijn recounted lessons learned: start at the pilot level; take a broad and holistic view of science; forge partnerships; look for opportunities to shape policy; and, approach funders with the attitude that, "It is easy to say yes, hard to say no."

"Government employees should become members of scientific organizations ."

- Kevin Shortt

Dr. Robert Mann, physics professor at the University of Waterloo and the president of the Canadian Association of Physicists (CAP), described how CAP is advocating for excellence in physics education and research in a rapidly changing research landscape (i.e. the Science Policy Advisor replaced by Science & Technology Innovation Council; the launch of the

Canadian Foundation for Innovation; the NSERC's grant selection process undergoing its biggest change in history; and, the rise of new research labs like the Canadian Light Source and the Institute for Quantum Computing). CAP's activities include Annual Congress, National Physics Journal, prize exams, and a new award for excellence in teaching high school physics. Its science policy committee works independently and with groups like PAGSE to lobby the federal government. CAP is lobbying for physics education research, basic research funding, and a design study for a Canada Neutron Centre to replace the Chalk River Reactor, which is scheduled to shut down in 2016. Mann said that CAP is under-resourced with just 2.5 full-time employees, giving it an inadequate ability to analyze "science for policy and policy for science," and limited media contact and coverage.

"Investing in discovery research provides the biggest payoffs."

- Dr. Reinhart Reithmeier

Dr. Reinhart Reithmeier, professor and department chair of Biochemistry, University of Toronto talked about how the Canadian Society for Biochemistry and Molecular Biology (of which he is former president) messages decision-makers. He said scientists' key messages to the public should be: "not what we do but *why* what we do is important; that scientists are very ordinary people but they do extraordinary things; and, investing in discovery research provides the biggest payoffs." To illustrate his last point Reithmeier recounted being introduced to lasers as an undergraduate student in the late 1960s. "They told us that one day we were going to have these big powerful lasers that were going to cut metal. Now we use lasers to buy our groceries, play our music, and do our surgery—we never dreamt of this in the late 1960s." Reithmeier made a plea for unrelenting support of research and innovation, and for support of youth interested in science.

During the question and answer period, Karen Hecht, a Canadian graduate researcher in biosciences at the University of Pittsburgh asked, "What can organizations like PAGSE do to involve graduate students and provide an outlet for their enthusiasm to get involved in promoting science?" Kassen said PAGSE is talking about different models, suggested following U.K. and U.S. programs where PhDs or postdoctoral students intern in government, but said he's not sure if PAGSE is the right group to organize it. Many panelists told Hecht that it's up to the graduate student to show initiative, commitment, and to seek out opportunities, and said that informing academic supervisors about these activities is also important.

Amanda Barry, a science and technology policy analyst for Environment Canada asked, "How do you conceptualize government researchers and technologists as part of your community?" Kassen said at PAGSE "government researchers are an integral part of our group. They come and speak to us at our monthly meetings. We've got a fairly close connection." Reinhart responded that the Canadian Society for Biochemistry and Molecular Biology has many members who work in National Research Council labs and other government spaces; Mann said CAP has some connections but would like to enhance them admitting the organization is dominated by university academics; and, de Bruijn said CRKN's membership is exclusively universities—it's working closely with government to find ways for academia and government to share content, but given the dearth of cooperation between government departments themselves, it's a major challenge; Shortt suggested government employees should become members of scientific organizations that match their interests to build relationships, and share knowledge. ■

From L-R: Dr. Christian Burks, Dr. Marc Fortin, Dr. Nils Petersen, Dr. Bryn Williams-Jones

GOVERNANCE OF EMERGING TECHNOLOGIES

PANELISTS

Dr. Christian Burks
President and CEO, Ontario Genomics Institute

Dr. Marc Fortin
Asst. Deputy Minister, Agriculture and Agri-Food Canada

Dr. Nils Petersen
Director-General, National Institute for Nanotechnology

Dr. Bryn Williams-Jones
Assistant Professor, Université de Montréal

MODERATOR: Dr. Patricia Kosseim
Genome Canada

Moderator Patricia Kosseim of Genome Canada introduced the panel discussion on governance of emerging technologies by distinguishing the concept of "governance" from that of "legislation"—terms that are commonly used (or at least thought of) interchangeably. By the time proposed legislation or regulations are being considered, they are usually an attempt to play "catch up" to emerging technologies, and are often invoked as a last resort to address a threat or "mischief" which has already materialized and requires the firm intervention of "law-makers." Governance, on the other hand, encompasses all of the upstream policies, resource allocation choices, multi-stakeholder mechanisms, structures, and processes designed to proactively anticipate, manage, and address both the risks and opportunities associated with innovative technologies as they develop. This panel on "Governance of Emerging Technologies," Kosseim said, is about "governance" in the latter, broader sense.

Dr. Christian Burks, president and CEO of the Ontario Genomics Institute, briefly discussed his work with the Ontario Genomics Institute (OGI), which partners with Genome Canada, Ontario's Ministry of Research & Innovation, and international funders of genomics work to develop, fund, and manage genomics projects led by Ontario scientists. Burks said that while most "research resources," which can include methodologies, datasets, and software, are either best placed in universities or with industry, there are some resources developed to be kept in academia that have matured to the point of requiring a production mindset which makes it difficult to maintain them in academic settings as by-products of basic research grants, but that are insufficiently commercial

to be placed in the private sector. Such resources, Burks said, ought to be supported by the public sector when there is clear benefit to Canada and the world in doing so.

Burks then explained that "genomics" is a holistic, systematic and high throughput experimental strategy to develop vital life sciences resources. It does so with the aid of new methods, software, databases, and technology platforms.

He gave examples of two research resource programs OGI has funded, and which had both successfully created or contributed to large-scale resources: the first, the Structural Genomics Consortium, has determined over 1,000 protein 3D structures and made them available through the global open access protein databank, PDB, funded by the U.S. and other countries; a second project created a major global resource, the Biomolecular Interaction Network Database (BIND), which focused on protein interaction maps. Unfortunately, when research funding ended, there were no separate funds to sustain the BIND resource, and the project halted. Burks concluded by calling for more sustainable, extended funding for research resource maintenance once resources have moved past the "research" phase in which they are initially developed, and when they have clearly established themselves as vital for the international community. He was hopeful that the upcoming Science, Technology, and Innovation Council of Canada report might recommend that Canada do so, and thus move to a position of leadership with respect to research resources, and as established by other countries, such as the U.K. and the U.S.

Dr. Marc Fortin, Assistant Deputy Minister of research at Agriculture and AgriFood Canada, argued that scientists and policy makers need to move from "industrial age governance," which consolidates bodies of knowledge in separate departments (e.g. departments of biochemistry and physics in academia, or departments of health and environment in government) to "information age governance," where "knowledge is distributed across broad and flat networks," and where policy makers can react more nimbly to complex problems. Fortin noted that the concerns he gets in his inbox often do not "fit neatly into one department" but deal with broad issues, like sustainable economies, climate change, energy and materials, and the health of our citizens. He argued that while reshaping government to better address these problems will be difficult, "We all own part of the solution."

A first step towards adopting "information age governance," Fortin said, is to set up cross-department innovation platforms. He noted that in April, the federal government put forward $158 million to fund proposals for such platforms. A second step would be for government to move beyond funding only research, to partnering with the venture capital community and other sectoral actors to support policy and research skills development, commercialization and markets, address regulatory reform, and move towards high-risk, longer-term initiatives for the public good. Fortin wants government not to "get out of the way," but

Governing nanotechnology will take more than a one-size-fits-all solution.

to become "a catalyst where a different set of relationships are created." Government needs to create the space and the conditions for the right people to interact with each other and encourage pure knowledge discovery, unfettered by intellectual property or commercial considerations. Advocates for this approach, Fortin argued, could gain backing by asking bold questions, such as, "How can we make Canadians the healthiest people on the planet?" If the science policy community can

answer these questions, Fortin said, they will win decision-makers' support.

Dr. Nils Petersen, director-general at the National Institute for Nanotechnology, argued that nanotechology is here to stay and that it will "change everything;" therefore, governing it will require more than a "one-size-fits-all" model. Nanotechnology, Petersen said, began with the invention of the X-Ray in 1895. It is seen as new because it was only 30 years ago that it let scientists "put atoms where we want to put them" rather than simply observe them. Petersen argued that nanotechnology is so powerful because it lets scientists reduce materials to very small sizes, unlocking new properties in the process; it allows scientists to make solders without lead because the melting point of pure materials lowers naturally as they are made smaller; it could find a way to remove the tiny solids suspended in Alberta tar sand oil without expending as much energy; and, quantum dots, which emit at different colours—depending on their size—could help physicians follow individual molecules in the body and diagnose disease.

Petersen noted that the nanotechnology industry generated revenues of $50 billion in 2006 and $127 billion in 2007. He expects it to become a $2.5.-3-trillion industry by 2015. Nanotechnology is already used to make everything from crayons to baby mugs, the latter of which contain silver nanoparticles that have antimicrobial properties. What nanotechnology has so far avoided, Petersen said, is the sort of public relations crisis—like what the GMO industry has suffered from—that invites public criticism and misinformation, and weakens technologies' commercial potential. This means that nanotechnology scientists and policy makers have the luxury to anticipate problems with nanotechnology and work out regulatory issues early.

But Petersen warned against "one-size-fits-all" regulation, adding that regulating "nanotechnology" as a whole, rather than tailoring regulations to specific

From L-R: Dr. Marc Fortin, Dr. Bryn Williams-Jones

nanotechnology products, is problematic. Berkeley made this mistake when it issued Ordinance 6,960-NS, which defined anything less than 100nm as nanotechnology. It meant that everything from soap film to ice cream—its crystallites are less than 100nm in width—would be considered nanotechnology, and would therefore be subject to stricter regulation than, for example, 500kg of mercury. Petersen concluded by calling on nanotechnology researchers to provide and be cognizant of the benefits and risks of their products, and to be careful to make accurate claims while correcting false ones.

Dr. Bryn Williams-Jones, assistant professor at the University of Montreal's School of Public Health, said that while most discuss genomics in exclusive reference to medical tests, consumer genomics increasingly includes tests for nutrition, ancestry, paternity, and forensics. He added that there is a global market for this testing—over 35 labs sell the results of 1,700 clinical genetic tests online, often directly to the public. He noted that these tests are often complex and, therefore, speak in terms of risk, rather than certainty. For example, while a test for Huntington's disease deals with only one gene, and therefore can give certain results, new tests, like those for certain kinds of cancers, test several genes and therefore are useful only in assessing risk.

These tests, Williams-Jones said, raise two traditional ethical challenges: One is informed consent—patients will be making decisions based on ambiguous, less-than-reliable test results; another is justice and access—the public needs to determine which of these tests are important enough to be made accessible to everyone. Firms like 23andMe, Navigenics, and deCODEme are engaging an interested public in science. People use social networking to communicate with others about health conditions their online tests indicate they are at risk of developing. "Fun" tests, like those on ancestry, could be shared with friends for entertainment.

Williams-Jones concluded that the debate over how these tests should be regulated fits into the same dialogues the science policy community has been having for the past 20 years. If one views genetic tests as a medical procedure, the regulatory approach one advocates for is a paternalistic one, which bans tests not mediated by physicians. If one views them as a consumer product, however, the answer is to educate the public and let them buy the tests they want.

Williams-Jones emphasized that there are no easy answers to this dilemma and that any regulation governments impose will likely need to be international rather than national, as globalization makes it easy for consumers to cross national borders to evade individual countries' regulations.

A questioner noted that the National Centres of Excellence (NCEs) seem to fly in the face of Fortin's assertion that government is not working across sectors. He asked the participants if they could discuss who should be making the rules with regard to emerging technologies. Fortin responded that investment in the NCEs is modest, only $4-10 million per centre, per year, and that government should not dictate new rules, as it can't solve many of the big problems with regard to technology alone. Petersen added that much of this governance will need to be international, as national borders are becoming less important.

Williams-Jones noted that it is difficult for governments to engage with the public on these matters; while the EU has done a lot of engagement, he wonders "whether they've made a damn bit of a difference." ■

From L-R: Randal Goodfellow, Dr. Geoff Munro, Dr. Hadi Dowlatabadi, Dr. Andrew Miall.

CANADA'S ENVIRONMENT AND ENERGY POLICIES

Meeting the Challenges Ahead

PANELISTS

Dr. Andrew Miall
President, Academy of the Royal Society of Canada

Dr. Hadi Dowlatabadi
Canada Research Chair, Professor of Applied Mathematics and Global Change, UBC

Dr. Geoff Munro
Assistant Deputy Minister, Natural Resources Canada

Randal Goodfellow
Senior VP, Corporate Relations, Ensyn

MODERATOR: Julia Deans
President & CEO, Toronto City Summit Alliance

Julia Deans, CEO of the Toronto City Summit Alliance, moderated the panel on meeting the challenges ahead and Canada's policies on environment and energy.

Dr. Andrew Miall, president of the Academy of the Royal Society of Canada at the Innovation and Energy Technology Sector at Natural Resources Canada, identified two intersecting problems: First, energy depletion—the world's remaining oil reserves will likely be exhausted within 40 years; and second, greenhouse gasses—32 billion tonnes of carbon dioxide are emitted worldwide every year. The government's response to these problems, Miall said, has been "confusing and contradictory," while media coverage has centred around conflict, rather than facts. Meanwhile, the world will need to turn to high-cost, high-risk reserves—like those off the coast of Angola—and offshore reserves with water depths of five kilometres or more. Prices will not gradually rise as oil supply falls but jump suddenly; market forces will not prepare consumers to switch to alternatives.

Miall argued that it is unrealistic to believe renewable energy can replace nuclear power. All of the wind projects under development in Ontario will provide only 1.8 per cent of its energy needs. One would need a solar panel large enough to cover downtown Toronto to rival the amount of power generated by one nuclear plant. Dedicating all U.S. corn and soybean production to ethanol, Miall added, would meet only 12 per cent of U.S. gasoline demand and six per cent of its diesel demand. The Alberta oilsands, Miall said, are expected to provide only three per cent of world demand—"little more than a rounding error." Nuclear, Miall said, is the only large-scale, efficient energy source. Ontario nuclear plants are very safe, Miall added; spent fuel rods can be buried in the Canadian Shield. Miall concluded by calling

on governments to impose higher gas taxes and on the media to stop talking down to its viewers. He recalled that in the early 1990s the Chrétien government managed to convince Canadians to make sacrifices to eliminate the federal deficit; he believes a similar effort should be made to balance Canada's carbon budget.

"[Environment] is not something [government] can treat like an extra vegetable on the plate.
It is the plate."

- Dr. Hadi Dowlatabadi

Dr. Hadi Dowlatabadi, Canada research chair and professor of Applied Mathematics and Global Change at the University of British Columbia, echoed Miall's sentiments about there being a disconnect between "high-level" and "low-level" action on energy in government. He noted that this disconnect has led to misinformed positions in Kyoto and Copenhagen. Al Gore, for example, attended Kyoto and set a seven per cent reduction target without talking to his technical team. Canada decided to set its targets one per cent lower than Gore's, despite Canada having a faster-growing population and a lower reliance on fossil fuels than the United States. Dowlatabadi argued that environmental concerns must carry far greater weight in government, saying it "is not something you can treat like an extra vegetable on the plate. Environment is the plate." He added that if he were environment minister, he would want the power to control other ministries' budgets.

Dowlatabadi cited several technologies Canada should place greater emphasis on, including canola biodiesel, ground source heat pumps, and distributed polygeneration. He projects that ground source heat pumps and polygen would save 60 million and 75 million tonnes of carbon dioxide per year, respectively. Though heat pumps are expensive, cities could create an inexpensive ground source infrastructure by using public lands for heat exchange with the earth and laying an extra pipeline along with water and sewer to provide low-grade heat to consumers (and take away heat where needed). Dowlatabadi added that there is not going to be anywhere near enough GHG mitigation to prevent substantial climate change. Hence, Canada needs to adapt to climate change and its impacts. "When we find these impacts to be unacceptably high we will resort to geo-engineering," he said. Dowlatabadi concluded that governments need to build their internal capacity to solve environmental and energy problems, integrate policies across different portfolios and levels of government, and create more "extension programs" for research.

Cutting climate emissions will take more than a silver bullet – it'll take a silver buckshot.

Dr. Geoff Munro, chief scientist and assistant deputy minister of the Innovation and Energy Technology Sector at Natural Resources Canada, described his job at the federal government as two-fold: to drive innovation in government and ensure relevant actors are working together. He urged scientists to try to design their research to work within the infrastructure of the actors that will need to implement it, whether that's the federal or provincial governments, or industry. If they don't, Munro said, "We'd might as well just pack up and go home." Munro outlined some of the challenges the world will face over the next half century: by 2050, world population is predicted to reach nine billion and energy demand will have increased 145 per cent. Canada has committed to cut emissions 20 per cent below 2006 levels by 2020, and 60-70 per cent below 2006 levels by 2050. Munro added that we must recognize that the energy industry constitutes seven per cent of Canada's GDP.

Munro argued that Canada can reach its

2020 climate goal using a "silver buckshot"—a mix of currently available green technologies. The missing ingredient is a "culture change" toward conservation on the part of Canadians. In Munro's view, scientists need to direct their attention toward Canada's 2050 climate goals, which today's technology cannot achieve. This will require more collaboration between scientists, policymakers, and industry—and more commercial investment in research and development. Munro argued that Ottawa can mobilize innovation by putting in place the right policies, institutions, and incentives for industry and scientists to work towards Canada's goals. He noted that Minister Lisa Raitt was talking to industry and scientists in a series of renewable energy roundtables. He also cited new Integrated Community Energy Systems in Guelph, Ontario, which is building a 'greenfield' in its downtown core, and Okotoks, Alberta, which has selected a block of 50 homes to run on 90 per cent solar power.

Randal Goodfellow, senior vice president of Corporate Relations at Ensyn, discussed his company's work. Ensyn is a second-generation biofuels company supported by private and public funds. They use rapid thermal processing technology (RTP) to turn non-food cellulosic feedstock into pyrolysis oil. The fuel can be used where it is produced, stored, and transported, and will soon be refined for use in cars, trucks, and airplanes. Goodfellow added that the fuel is virtually carbon-neutral. Ensyn, Goodfellow added, answers the oil industry's demand for a biologically-based fuel that can be processed in the same manner and use much of the same refinery infrastructure as crude oil. It is far more efficient than ethanol, Goodfellow noted, gaining 70 per cent yield from its biomass, rather than the 20 per cent yielded from cellulosic ethanol.

Goodfellow argued that the environmental benefits that are being sought are only realized when new less environmentally impactful products are being consumed in the market. He urged governments to look closely at the material flow chains and to identify where technology or science is deficient, and to focus research on these areas. He added that the federal government should be the first to adopt new Canadian products and technologies, adding that the first question he is often asked when selling to foreign firms is, "Does

your government use this product?" He also urged scientists not to focus solely on "hot topics" like genomics and nanotechnology.

During the question and answer period, Dr. Mihaela Ulieru, a Canada Research Chair at the University of New Brunswick, asked Munro, "How can we untangle the policy web" to help companies like Ensyn develop new technologies. Munro responded that some solutions being pursued now include institutes that bring together government and industry to work on common issues—like the National Institute on Nanotechnology.

"[Canada is] trading off 40 years of oil for 60 years of uranium."

- Dr. Dominic Ryan
Professor of Physics, McGill University

Dr. Dominic Ryan, a professor of Physics at McGill University, asked Munro why the federal government had no plan in place to deal with the Chalk River reactor crisis. He also argued that to avoid "trading off 40 years of oil for 60 years of uranium, Canada should adopt more efficient Gen-4 nuclear technology. Miall added that Ottawa's drive to "outsource and privatize everything" severely weakened the government's corps of scientists. Munro replied that while current government efforts are "not enough, no argument," looking at how and where to develop nuclear capacity is "a very weighty and costly decision." Ryan noted that he sat on a selection committee for a new site for the Chalk River plant ten years ago and denounced Natural Resources Minister Lisa Raitt for not addressing the crisis, saying, "She recognized it was sexy then and was still doing nothing."

Dr. Duncan Stewart, research physicist at the National Research Council, recalled that 50 years ago, Chalk River employed the best neutron scientists in the world. He wondered whether the federal government's move over the past 20 years to fund universities to a greater extent than laboratories was the right one. Dowlatabadi replied that there "need to be less paper-pushers" in government. He recounted "my horror" when he found out the funding for his Canada Research Chair was taken from the National Research Council of Canada's budget, calling it—"a ridiculous position to put me in." Miall compared research scientists to "footballs" being kicked around to and from mercurial politicians' pet projects. Dowlatabadi noted the need to foster greater science and technology literacy in government and to support many more researchers and technicians with the understanding that they serve society by doing relevant research as well as performing critically needed extension services.

Dr. Jason McKeever, a post-doctoral fellow at the University of Toronto, doubted that given frequent cost overruns and the dwindling uranium supply, governments should continue to rely on nuclear plants. Miall responded that large-scale energy capacity can only come from coal, natural gas, or nuclear power. Dowlatabadi added that renewables are difficult to integrate with the existing grid due to their intermittent supply necessitating a great deal of back-up power and noise that is difficult to mask without significant investment in power electronics.

A participant interjected, "Fifty years of uranium, 300 years of thorium, am I wrong?" Ryan added that India recently reverse-engineered Canada Deuterium Uranium (CANDU) technology it bought from Canada, so that it could be powered by thorium—a far more plentiful radioactive material.

Dr. Martin Taylor, president and CEO of Ocean Networks Canada, said he felt encouraged by Munro's remarks, adding that some participants were "belabouring some of the bad examples [from government], and not talking about some of the good examples." ■

From L-R: Dr. Brian Underdown, Dr. Eric Archambault, Dr. Philip Schwab, Rachel Woen Tjoen Soen, Dr. Peter Frise.

PRIVATE SECTOR RESEARCH AND DEVELOPMENT

Its Role in the Global Economy

PANELISTS

Dr. Eric Archambault
President, Science-Metrix

Dr. Peter Frise
CEO, AUTO21; Professor, University of Windsor

Dr. Philip Schwab
Vice President, Industry Relations, BIOTECanada

Dr. Brian Underdown
Managing Director, The Lumira Group

MODERATOR: Rachel W. T. Soen
Bombardier Inc.

Rachel Woen Tjoen Soen of Bombardier moderated the panel on the private sector's research and development role in the global economy.

Dr. Peter Frise, professor of Engineering at the University of Windsor and CEO of AUTO21, presented on the current state of the auto industry, research partnerships in the auto industry, and how Canadian research and development and the global auto industry affect each other. He argued that while the auto industry is here to stay, it is undergoing profound change—and for the auto industry, change is expensive. It costs $1–5 billion to develop a new car design, and $600 million to $1 billion to perform a tooling upgrade. New U.S. fuel economy regulations will cost the auto sector at least $140 billion in research and development, and the need to retool to face rapidly changing consumer preferences will inflate the industry's costs even further. In 2006, trucks and SUVs represented the bulk of the Canadian auto market but Frise expects an even split in demand between cars, crossovers, and trucks and SUVs by 2012.

The Canadian auto sector is worth $119 billion a year and employs 100,000 Canadians directly.

Frise emphasized the auto industry's importance to Canada. Canada is home to 18 vehicle assembly plants and 400 parts suppliers and manufacturers. The auto sector is a $119 billion-a-year industry for Canada, employing 100,000 Canadians directly and 300,000 Canadians indirectly. Frise argued that researchers looking to

gain funding from the auto sector should find out what the industry needs and align their research proposals to those needs, and show strong respect for firms' intellectual property. Frise added that the federal government should support the auto sector by strengthening its intellectual property laws and gear its funding policies to recognize that commercialization, rather than research, which is a hurdle for the auto sector: for every dollar spent on research, it costs $500–$1,000 to turn that research into a product. Frise concluded by speaking about AUTO21, which works to reconcile the goals of academics (publishing research), industry (gaining patents), and the public (innovations and products that improve their quality of life). AUTO21 employs 548 graduate students across the country.

Canada spends far less on research and development relative to its GDP than other mid-sized countries.

Dr. Eric Archambault, President of Science-Metrix, presented on Canada's trade deficit in high-tech goods. This deficit grew from $20 billion in 1990 to $70 billion in 2008, the result of which is that Canada's performance lagged far behind eight other small countries: Austria, Belgium, Denmark, Finland, the Netherlands, Norway, Sweden, and Switzerland. Archambault noted that all of these countries, like Canada, are social democracies with relatively high taxes and wages. Norway also resembles Canada in that it has a largely resource-based economy. However, Archambault found that Canada spends far less on research and development (R&D) relative to its GDP than these eight comparable countries: while Canadian R&D spending ranks 14 per cent better than the OECD index, the other countries perform over 100 per cent better than this index. In addition, Canadian firms obtain fewer international patents than most of these countries. Canada's OECD patent index is 1.73, while Finland's, for example, is 5.91. Canada does hold a large number of U.S. patents, but Archambault argued that Canada should take a global approach to intellectual property rather than a continental one. Archambault told participants that firms, rather than academia or government, are to blame for Canada's high-tech trade deficit. They are not investing enough in commercialization and do not obtain enough international patents to create a comparative advantage for Canada.

Dr. Philip Schwab, vice-president of Industry Relations at BIOTECanada, argued that by

the year 2020, Canada will "become the world's leading bio-based economy." Over 500 companies in Canada are engaged in biotech that generate $4.2 billion in revenue per year and invest $1.7 billion per year in research and development, representing 12.3 per cent of Canada's business expenditures on research and development. He cautioned against paying attention to "headline-grabbing activists" who, after 15 years of safe use of biotech food products, still insist that the precautionary principle apply to biotech. He added that government needs to align its policies to enable more research and commercialization to ensure Canada leads in the biotech industry. This means stronger intellectual property protection, and coherent public-private intellectual property transfer policies. It also means following the United States in investing in "orphan products" (medications for people with rare diseases) that will never be able to cater to a large market alone.

Schwab gave two measures for success: the extent to which the world is investing in Canadian companies and the extent to which biotech improves Canadians' lives. Biotech products currently under development include non-browning apples, drought-resistant crops, and alternative fuels. He noted that foreign firms have invested $2.2 billion dollars to acquire Canadian companies in the past two to three years, a sign of confidence in Canadian researchers and executives. Schwab concluded by telling participants, "science policy is more than how much funding flows to research organizations; it is also tax, market access, and regulatory policy. These policies need to develop along with our science to realize a return on our investment."

Foreign firms have invested $2.2 billion to acquire Canadian biotech companies.

Dr. Brian Underdown, managing director at the Lumira Group, argued innovation policy should foster an "ecosystem" of cooperation between academic research institutions, innovative companies, and government. He added that university research should continue to focus on "fundamental curiosity-oriented research," but also suggested that Canada's university system should be open to differentiation in which some universities would be known as research-intensive institutions while others would adopt the tradition of smaller liberal arts universities where a spirit of inquiry is fostered through high-intensity faculty contact with students. Canadian government support of SME's should include strategies that would promote lasting footprints including manufacturing facilities that would be difficult to move offshore once established, such as highly-validated vaccine or drug manufacturing facilities. Funding should also be directed to companies that build the type of plants that will train and maintain a strong, talented workforce, as many of those workers will spin off and found their own small and medium enterprises in Canada.

Underdown argued that Canada's Scientific Research and Experimental Development tax credit (SHRED) programs should be supplemented by direct government grant programs such as SBIR-type grants as are available in the U.S. Such direct grants are non-dilutive and create value without driving up valuations that venture investors look for when investing. While the SHRED program has been very valuable for Canadian companies, accessing SHRED dollars requires dilutive dollars and indirectly provides upward pressure on valuations of tech companies. Underdown suggested that Canada build specific research and development strengths into concentrated areas—like Waterloo did for software engineering—to create economies of scale that serve as a magnet for entrepreneurs. He added that foreign-owned companies should be encouraged to work in Canada because they create highly-

skilled Canadian jobs and, in turn, Canadian spin-off companies. Underdown also recommended that Canada position its academic technology transfer offices as "open for business." But he added that while these transfer offices should ensure inventors receive adequate benefit for their products, the offices themselves should not be profit-driven, as this will make deals more expensive and therefore less enticing to venture capital.

During the question and answer period, Bruce Radburn, senior advisor for Innovation Policy at Agriculture Canada, asked how government can respond to the increasing globalization on innovation. Schwab replied that a lot of new companies go public because they lack late-stage capital. But when they do, their SHRED tax credit is halved, because they are no longer considered Canadian-owned. He said he called this policy "parochial" and argued that any company that creates Canadian jobs and intellectual property should receive government help. Frise said that while SHRED has been a "terrific instrument," its requirement that a company make a profit is unhelpful in a recession.

Dr. John Leggat, president of the Canadian Academy of Engineering, asked panellists what Canada can do to find the capital to bring Canadian products to market. Frise replied that government should stop worrying about whether it should directly support commercial research and development, and "just do it."

"Parochial."

- Dr. Philip Schwab on the SHRED tax credit

Jeffrey Crelinsten, president and co-founder of The Impact Group, cited a study his group had conducted that found failed biotech companies were well-funded, even though a third never had a customer. Many, he added, performed contract research to help pay for the unprofitable idea they were founded to sell. He asked why anyone would want to fund biotech companies when their attitude towards profits amounts to "oh we're biotech . . . of course we can't make money, of course we can't have customers."

Underdown replied that there are many barriers to entry for biotech companies, and that it's up to investors to decide whether a company should sustain itself by directing attention away from their "big idea" towards contract research. Underdown also argued that to be successful, Canada needs to create companies that are targeted to global markets. For example, it has been alleged that government might be reluctant to invest in the life sciences sector because of fear that new products would inevitably drive up health-care costs. Underdown suggested that the emphasis should be on supporting companies that develop products with high cost/benefit as opposed to focusing solely on costs. Such products would find customers around the world, generating more exports, and more revenue, for Canada.

A master's student from the University of Toronto asked whether the panellists felt universities were graduating enough PhDs. Underdown and Schwab agreed that Canada is not short of PhDs, it's short of PhDs with experience as managers and entrepreneurs. Frise argued this was one of the reasons Canada underperforms in innovation. Underdown noted that he was aware that a National Centre of Excellence had offered a program allowing graduate students to work at a biotech company for a year, but few had applied, possibly because students and their professors had not embraced the value that working with industry would bring. Archambault predicted that the difficult academic job market would push more Canadian PhDs into industry. ■

From L-R: Dr. Jorge Niosi, Mark Romoff, Dr. Ronald Dyck, Dr. Tom Brzustowski, Dr. Jeremy Grushcow.

INNOVATION COMMERCIALIZATION

From Bench to Market

Dr. Tom Brzustowski
RBC Professor, Telfer School of Management, University of Ottawa

Dr. Ronald Dyck
Assistant Deputy Minister, Research Division, Alberta Advanced Education and Technology

Dr. Jorge Niosi
Professor, Department of Management and Technology, Université du Québec à Montréal

Mark Romoff
Former President and CEO, Ontario Centres of Excellence

Dr. Jeremy Grushcow
Lawyer, Ogilvy Renault LLP

Moderator Dr. Jeremy Grushcow, a corporate lawyer at Ogilvy Renault LLP, and founder of the Cross-Border Biotech Blog, began the discussion on policy initiatives to bring technology to the marketplace.

Tom Brzustowski, RBC professor in the Telfer School of Management at the University of Ottawa, presented his ideas for a Canadian science and technology policy that could drive our future prosperity. He said Canada needs to use its science and technology capabilities better to add value in industry and create more wealth. This requires treating entrepreneurship strategically and seizing spin-off opportunities. He suggested the science and technology policy should bundle Canada's most successful research programs—such as the Industrial Research Assistance Program—into a strategically coherent system, put most post-secondary research support on a five-year growth track to compete globally, with even faster growth of research done with industry partners. The

policy should identify areas of government research that contribute to science and technology capabilities and make collaboration with it easier. He said such a policy would fund knowledge transfer offices at universities and colleges, roll out programs like Quebec's College Centres for the Transfer of Technologies nationally to help SMEs grow, and develop government expertise in international intellectual property rights, all of that to put research-based new technology to work in wealth creation in the Canadian economy as quickly as possible.

Dr. Ronald Dyck, Assistant Deputy Minister Research Division, Alberta Advanced Education and Technology, said a renewed research and innovation system, "Alberta Innovates," which is about to be launched by his ministry, is a microcosm of what Brzustowski had just described. Following a comprehensive review of Alberta's research and innovation system and several major consultation events with science and technology strategists, research funders, research performers and industry—Alberta is launching a more integrated and aligned research and innovation system that will facilitate achieving both application and economic benefits, which will enhance the capacity to bring technology to market. "Alberta Innovates" is the "umbrella" which represents the creation of four new corporations (Health Solutions, Bio Solutions, Energy and Environment, Technology Futures) and one research and innovation advisory body (Alberta Research and Innovation Authority). The corporations will work closely with both relevant government departments and industry in facilitating the development of knowledge and technologies to inform policy and/or to solve "grand" challenges. "Technology Futures" is a corporation that is the result of merging three existing organizations into one corporation and adding a number of government programs that support technology commercialization. Post-secondary institutions will continue to be active and integral participants in the renewed system as they serve both as the developers of high quality and skilled people and as key research performers. To that end, post-secondary institutional research plans will be an important element in ensuring that the capacity to undertake necessary research and development will remain strong and even enhanced in areas of priority. The Alberta Research and Innovation Committee is being created In order to ensure that all the elements of the system are working together. This committee is made up of the chairs of the four corporations and the advisory body and is chaired by the Minister of Advanced Education and Technology. In addition, a Portfolio Advisory committee consisting of cabinet ministers of research-relevant government departments, will provide advice to the Minister of Advanced Education and Technology about the allocation of funding to the four corporations. Dyck stated the new research and innovation system is now in legislation (Alberta Research and Innovation Act).

Mark Romoff, former President & CEO of Ontario Centres of Excellence Inc. (OCE), said this organization is "living the agenda every day." With eight offices across the province, OCE "pulls new technologies into the marketplace" three ways: first, determining what companies need to grow their bottom line and strengthen their global competitiveness and connecting them with leading academic researchers working in that field; second, going into universities to survey research and helping move ideas with high business potential into the market; and third, through OCE's Investment Accelerator Fund, investing up to $500,000 in a new or early-stage company, supporting entrepreneurs' efforts to turn new technologies into successful business ventures. OCE also has a number of programs directed at training and developing the next generation of innovators, entrepreneurs, and business leaders to better position them for success. OCE focuses its funding and support

programs in four priority sectors: biomedical technologies, clean-tech, digital media, and the green economy. Romoff highlighted an innovative new partnership with the University of Waterloo and the Waterloo Technology Park Accelerator Centre aimed at strengthening the commercialization success of university discoveries. It is hoped that this initiative will become a model across Ontario. He also outlined a precedent-setting partnership with the Ontario Municipal Employees Retirement Systems to support technology commercialization efforts of new start-up companies. He depicted this initiative as "game changing" given that pension funds have not previously played in this space. He described innovation as a contact sport and OCE as one of the leading teams in the league: "You have to be in the field, bumping up against all the key players in the innovation ecosystem, making it happen every day. But it's also a team sport, with strong collaboration amongst the players being a critical factor for success."

Dr. Jorge Niosi, professor in the Department of Management and Technology and Université du Québec à Montréal and a Canada research chair for Management of Technology, highlighted the "valley of death"—or gap between—an idea's invention and its commercialization. He said while Canada published more scientific papers per population than the U.S., we have a small internal market, few large firms, and seldom realize the market potential of homegrown scientific or technical ideas. He said the way to grow commercial output from academia is to give small and medium size enterprises funding to explore academic technologies. He would like to see Canada adopt the U.S.'s Small Business Innovative Research program (SBIR) and Small Business Technology Transfer Research program (STTR). SBIR is a $2.5 billion program, which has been adopted by India and Japan and is considered a major success story for its ability to attract venture capital and bridge the gap in technology development, and commercialization.

During the question and answer period, Jeff Crelinsten of The Impact Group said that the OECD measures output not input, and asked what indicators Canada should use to measure success in the commercialization of innovation. Brzustowski suggested measuring local economic activity by the number of companies that survive, create jobs,that have exploited and commercialized technologies out of research labs, as well as the growth of clusters around key institutions. Dyck suggested measuring the number of post secondary graduates that take a job in their region for the first five years after they graduate. Romoff suggested following startups over three to five years and looking at job growth.

A professor of chemical physics theory at the University of Toronto said he was "frightened by much of what I have heard here and, indeed, throughout the conference." He feared forcing responsibility for innovation and commercialization onto the universities poses a threat to the pursuit of basic science. Niosi clarified that, "We are not saying funds to basic science have to be cut, we are saying put commercialization in the hands of people who know it—companies. Give companies a chance to explore . . . because the public is writing the cheque, and every part of science has an opportunity cost."

Dyck said, "The innovation agenda is to move basic research to application," and lauded the pursuit of basic science. "If we had given an engineer the task of solving polio, what did we get—the iron lung; but giving the basic scientist that task, you got the vaccine."

Niosi recounted that most physicists viewed the Wright Brothers as "people playing with those toys trying to fly; they should know according to physics that no machine heavier than air will ever fly. Fortunately for them, inventors were ignorant of physics; so we need to give money to both basic science and commercialization." ■

THE DEMOCRATIZATION OF SCIENCE

PANELISTS

Dr. Elana Brief
Research Director, Women's Health Research Network

Dr. Ramin Jahanbegloo
Professor of Political Science, University of Toronto

Hiromi Matsui
Co-Chair, Women in Science, Engineering, Trades, and Technology

Dr. Marc Saner
Executive Director, Regulatory Governance Initiative, Carleton University

MODERATOR: Dr. Kathleen Bloom
President & CEO, Knowledge Impact Strategies Consulting

Moderator Kathleen Bloom, president and CEO of Knowledge Impact Strategies Consulting, began the panel discussion on the democratization of science by presenting her belief that stakeholders should drive knowledge transfer. She remarked that scientists—especially those 50 per cent who do not go into research—should be trained to provide this, and cited the University of Waterloo's "Science Shop" as a model example.

Ramin Jahanbegloo, professor of Political Science and research fellow, Centre for Ethics, University of Toronto, said he was disappointed with the turnout: "If you organize a conference on democratizing science in China or Iran, you will get 1,200 people." He described his concept of "The Science of Peace," saying science without democracy is arbitrary, and democracy without science is ignorance, but the interface between them is problematic; "We need a third concept of non-violence," he said. "Scientific inventions alone will not bring about a peaceful democratic world unless it includes non-violence as one of its goals." Jahanbegloo subscribes to the Ghandian principle that science's ideology of absolute truth is incompatible with humanity and nature. He said this ideology

promotes a culture devoid of spirituality and casts anyone who believes otherwise as irrational. "Scientific enterprise must be informed of the deep awareness of potential values it will create," he said.

Dr. Elana Brief (left)

Elana Brief, research scholar with the National Core for Neuroethics and president of the Society for Canadian Women in Science and Technology, remarked, "Democratizing science is about expanding who can participate in science, and this involves science appreciating and valuing other people's ways of understanding this world." She said science's implicit quantitative and qualitative valuation of objectivity and impartiality over relationships can be problematic, and called this an example of science not working in the service of the community or the experts —as certain evidence is ignored. She then outlined how to conduct community-based or participatory research by involving stakeholders starting from developing research questions to disseminating findings. Quoting Sandra Harding, she said, "If we start research from a woman's life we ask different questions, gather different data, and end up with a less partial—and less distorted—picture of the world."

However, Brief does not believe science is ready (yet) to invite the public to participate in basic science. She made a number of suggestions for democratizing science: she wants scientists and engineers to have a solid grounding in social sciences and humanities, and recommends they serve on government committees; and, she wants the public to have free access to scientific results and an obligation for public education to be linked to research funding. The public could get more involved via community-initiated research and citizen sabbaticals, or by paying people in the community to do research.

Marc Saner, Executive Director of the Regulatory Governance Initiative in the School of Public Policy and Administration at Carleton University, outlined a practical plan to democratize science by pinpointing areas where democratization is important and feasible. He proposed doing this by making more room for the public to determine where resource allocation in science and technology research, but he said this has to be done carefully and should not be applied to basic science, which should be left to the experts. He recommends measuring what Canadians value and "connecting it to high-level strategy setting"—as the government has done with bioscience; "leaving these value-judgements to the 'experts' is neither fair to the experts nor helpful to society," he said. "It's not the role of scientists to choose what part of the environment to protect, for example." He also wants to see the next version of the government's national Science and Technology Strategy to systematically build in societal preferences. Finally, he described a role for public engagement on risk issues in regulation, for example when the scope of regulations are decided, because these are values questions and cannot be left to technical experts.

"Scientific enterprise in Canada is a 'power elite' – their knowledge gives them status and power."

- Hiromi Matsui

Hiromi Matsui, researcher at Simon Fraser University and co-chair of the Women in Science, Engineering, Trades, and Technology (SETT project) for the Canadian Coalition of Women in Engineering, Science, Trades, and Technology (CCWESTT), said the "scientific enterprise in Canada is a 'power elite'—their knowledge gives them status and power." Canada needs to improve its innovation measures by supporting increased recruitment and retention of

women and men into science and technology. She said fewer women are studying science and engineering, and only 14 per cent of faculty in those areas are women. She hopes the CCWESTT's Women in SETT Centre, opening in Alberta on January 14, 2010, will improve recruitment, retention, and leadership from women in SETT.

During the question and answer period, Denise Amyot, president and CEO of the Canada Science and Technology Museum Corporation, said, "I would like to propose that we transform the way we think about museums and begin to use them as place to engage citizens, democratize science, and nurture scientific culture." Jahanbegloo responded that he dislikes museums and taking children to the Smithsonian to show them Apollo 13 will not teach them about the nature of science; other panelists and the audience disagreed, citing various examples of how museums are democratizing science (i.e. showing politicians exhibits on climate change and holding "citizen cafes" for scientists and public to converse). Saner suggested museums "are great forums for scientists to be challenged by the public in thinking about the kind of work they're doing, and can act as a venue for scientists to be transformed because they have room to speak with the public." ■

From L-R: Dr. David Rose, Dr. Sunny Marche, Dr. David Castle, Bonnie Schmidt

THE NEXT GENERATION OF SCIENTISTS

Science Education and a New Culture of Civic Engagement

PANELISTS

Dr. David Castle
Canada Research Chair, Science and Society, University of Ottawa

Dr. Sunny Marche
Associate Dean, Faculty of Graduate Studies, Dalhousie University

Dr. Andrew Miall
President, Academy of Science, Royal Society of Canada

Dr. David Rose
Chair, Department of Biology, University of Waterloo

MODERATOR: Bonnie Schmidt
President, Let's Talk Science

Bonnie Schmidt, president of Let's Talk Science, opened the panel on science education and civic engagement as they relate to a new generation of scientists by asking panelists to address several questions: "What does a scientific literate culture look like? Do we even need one? How do we benchmark it? Are we preparing the workforce for the future?" After brief introductions, the session was open for questions and discussion.

Dr. Sunny Marche, associate dean in the Faculty of Graduate Studies at Dalhousie University, said his definition of scientific literacy is "knowledge about science and the scientific thought process that will bring to bear protocols to reduce our cognitive bias." Marche said we have failed to produce scientific literacy in society because "critical thinking has been replaced with the rise of the opinion." He said every scientist should be able to explain their work to the public in three or four sentences and cite the cost, but that few, at least at the PhD level, are able to do so.

Dr. David Rose, chair of the Department of Biology at the University of Waterloo, said he approaches scientific literacy from an educational viewpoint. He believes the best way to raise the profile of scientific issues is "to provide as much education in school systems from the start, and to have an interactive and communicative scientific community that is visible and respected." He said the public is clamouring for information on issues like H1N1 and climate change, underlining the urgency of better interaction between scientists and the public.

Schmidt said that while the coverage of science by mainstream media has skyrocketed in the last ten years, "no one says we have a science literate community." She asked panelists to define science literacy. Rose responded, "It's when society takes a reasoned over emotional approach." Donna Francis, a researcher at the Ontario Science Centre, said, "people are scientifically literate if they have the

information or the ability to obtain the information they need to make rational decisions about issues in their lives." Marche cited an OECD and StatsCan study on literacy in Canada identifying four different kinds of literacy at five different levels; in the assessment, individuals must be at levels three, four, or five to participate in the knowledge economy, but 42 per cent of Canadians are at levels one or two. "So the prospect of developing science literacy among these Canadians … is relatively low," he said.

Dr. Andrew Miall, a geologist at the University of Toronto and researcher on energy and environment, said the "hopelessly simplistic" and "lazy" media coverage of energy and environmental issues has created a misinformed public. He asked, "How do we get over this in a time of declining resources for the media?" Miall said he wants people to understand the scale of the issue. In particular, understanding that renewable energy cannot replace oil and gas, and considering nuclear power as a viable option.

Mike Spear, director of Corporate Communications at Genome Canada and a former journalist, said, "The media's job has always been to tell a story compactly; if you want to tell a complete story, write a book." He said even if the public were to become science literate, this would not automatically lead people to behave according to the best scientific information. Instead, publicly-funded scientists have an obligation to communicate how the public can use science to better their lives. He slammed one of the panelists' condemnation of Twitter, saying, "If you apply a scientific method to it and figure out how to use it, it's a killer application."

Marche asked Spear, "What happens in between what the scientist says and what ends up in final media product?" He suspected editors were the gravest source of distortion. Spear said that while editors make mistakes, scientists need media and communication training. A post-doctoral fellow from the Princess Margaret Hospital suggested the problem with scientific literacy stems from the way science is taught. He asked, "How can we build an interdisciplinary approach in Canada from university all the way down to elementary?" Rose said undergraduate curricula should delay specialization in one element of science for as long as possible.

Dr. David Castle, Canada Research Chair in Science and Society at the University of Ottawa, said that before answering that question, Canada must know something much more basic: why we want science literate citizens. "OECD indicators show we spend a lot of money on research and we're leading on scientific publications, but we are lousy at translating science into products, services, and having a strong R&D culture. So, if that's what we want to address—if we continue to produce generalists who become specialists—that may or may not work. But, if you want citizens to be generally educated in science . . . changes in pedagogy could come into play. But you have to know your goals," said Castle.

Schmidt asked panelists what role the general public should have in science policy. Castle responded that it is easy to attract people with an interest in science to public forums on these issues, but it is difficult to convert those who are disinterested. "We need to get out there and get our hands dirty" by exploiting media connections and making science interesting, he said.

In closing, Rose said working with curious students and members of the public keeps him optimistic about the future; Marche said "the scientific community has a big opportunity to help us develop more effective thinking processes;" while Castle said pessimism drives him, particularly the drop in postgraduate science and engineering students, which needs to be addressed now lest Canada fall behind most other developed countries in its standard of living. ■

From L-R: Dr. Chantal Barriault, Nicola Jones, Mark Henderson, Paul Wells.

SCIENCE JOURNALISM, MEDIA, AND COMMUNICATION

PANELISTS

Dr. Chantal Barriault
Co-director, Science Communication Graduate Program, Science North

Peter Calamai
Science Reporter, The Toronto Star

Mark Henderson
Managing Editor, Research Money

Nicola Jones
Commissioning Editor, Nature

MODERATOR: Paul Wells
Senior Columnist, Maclean's

Moderator Paul Wells, senior columnist for Maclean's, began the panel presentation on science journalism and media by expressing his belief in the importance of science journalism and policy, which he said was reflected in his previous writing for the National Post.

Peter Calamai, a science reporter from the Toronto Star, who, absent due to sickness, submitted his talk via text read by Wells, focused on three main points: first, the decline of traditional Canadian journalism as an institution; second, observations of the vulnerability of science coverage in particular; and third, how Canada might improve its public discourse on science policy in light of these circumstances. Calamai described the dissolution of robust, "passionately disinterested" reportage in Canadian media since the 1960s into superficial coverage that stems largely from promotional press releases, attributing this decline to the advent of the Internet, which has reduced newspapers' annual revenues by as much as a third. He said that the rarity of strong Canadian science journalism, in particular, is a result of the increasingly common view among editorial boards that robust science reportage is inessential to their subscribers and, therefore, bottom line. He then pointed to a few causes of the moribund state of public discourse around science policy in Canada, including the impenetrable Canadian Council of Academies reports, the minister of science and technology's conflict over evolution, and the Science Technology and Innovation Council's (STIC) lack of transparency. Calamai concluded by suggesting the creation of an online magazine or forum dedicated to "boisterous" coverage of science policy issues, written by academics, policymakers, and journalists—akin to the Science Forum, a bi-monthly publication published from 1968 until the early 1980s—to fill the void.

Mark Henderson, managing editor of Research Money, spoke next, saying that as a professional who follows science funding issues closely, he is "astounded by the lack

of attention that the media pays to science funding issues" given the enormous amounts of taxpayer dollars that are at stake. Citing the same recent Statistics Canada report on research and development (R&D) funding as did Minister Gary Goodyear in his keynote address earlier that day, Henderson acknowledged that the federal government is allocating a record amount of funding to science and technology this year, totalling $10.7 billion. However, in contrast to Minister Goodyear's glowing praise of the move, Henderson said he "wasn't sure if he was looking at the same report;" as a percentage of total federal spending, the funds amounted to the lowest allocation to science and technology in ten years, and—between cuts to science programs from new government review processes and exceptionally targeted funding efforts of late—overall government spending for science and technology is "flat-lining," not improving, as Minister Goodyear had implied in his speech.

Government science and technology funding is flat-lining, not improving.

As a result of the lack of critical science reporting and public interest in Canadian science that Calamai cited, Henderson said the 2007 national science and technology strategy lacked public consultation in its conception, and is the strongest effort by the government thus far "to usher in a new era in targeted investment" where projects such as oil sands extraction are well-supported, and others, such as Genome Canada competitions, lack the money to even be considered. Henderson's suggestion for improving this situation, besides improving science media communication and journalism, is to push for the appointment of a senior science policy advisor with direct links to the Prime Minister's Office—or better still, an entire department.

Nicola Jones, commissioning editor of Nature, discussed the importance of distinguishing between science journalism, which is critical and analytical, and science writing, which is simply interpreting findings for a general audience. As with the two speakers before her, she stressed that the former—in Canada at least—is severely lacking, while in the U.K., however, science journalism is prevalent and well supported, and science policy issues are "the subject of frequent and loud debate."

Lastly, Chantal Barriault, co-director of the science communication graduate program at Science North, discussed her expertise in training people to communicate science issues and engage the public. She cited people's assumption that a lack of science issue awareness stems from ignorance and the belief that it can be fixed by transferring knowledge from experts to the public, a communication strategy called the "deficit model." However, she stressed the effectiveness of the "dialogue model," in which experts attempt to inform the public by discussing what they are interested in, in forums such as citizens' assemblies and cafés scientifiques. Barriault said that these techniques have been shown to work well in Europe, with previously uninformed groups coming to conclusions on science issues similar to what scientists themselves would have made. ■

Good science coverage is rare because editorial boards think it's insubstantial to subscribers and, therefore, their bottom line.

From L-R: Dr. Sun Yongjian, Brian Wixted, Valerie La Traverse, Dr. Margaret Dalziel, Tony McBride, Dr. Alex Bielak, Paul Dufour.

BEST PRACTICES IN SCIENCE POLICY FROM OTHER COUNTRIES

Paul Dufour of Natural Resources Canada moderated the panel presentation on science policy from other nations.

Dr. Alex Bielak of Environment Canada (EC) began by rejecting the premise that Canada "lags behind the rest of the world" in science policy. He argued that much is being done by individuals and small groups with relatively few resources, and that others nationally and internationally are paying attention to what is happening in Canada. Bielak noted the increased importance of—and rising demand for—knowledge brokers to bring the scientific and policy communities together. "They need to be skilled in both worlds; they need to be trusted; they need to be able to formulate researchable questions," he said. Bielak described how EC created a dedicated knowledge translation and brokering unit for its Science and Technology Branch to improve science-policy linkages by targeting audiences to facilitate policy development and refine research directions.

Tony McBride, head of strategy at The Royal Society Science Policy Centre in the U.K., gave an overview of the work of the Society. He spoke about the U.K.'s science and innovation framework as a tool for strategic investment, linking science to the country's economic performance. "The primary language of government remains economics and science policy must speak in that

PANELISTS

Dr. Alex Bielak
Director, Science and Technology Liason, Environment Canada

Dr. Margaret Dalziel
Associate Professor, University of Ottawa

Valerie La Traverse
Science and technology counsellor, Canadian Embassy in Washington, D.C.

Tony McBride
Head of Strategy, Science Policy Centre, UK Royal Society

Brian Wixted
Founder, Technomics Research

Dr. Sun Yongjian
Science and Technology Counsel, Consulate General of the P.R.C. in Toronto

MODERATOR: Paul Dufour
International Science and Technology Advisor, Natural Resources Canada

language too," he said. McBride also spoke about an evidence-based approach to policy development and the importance of having parties outside of government shape science policy. McBride stressed the importance of non-governmental advice for policy that is independent and peer reviewed, and said that governments should draw the best available scientific expertise, wherever in the world it is to be found.

Beijing plays a leading role in fostering innovation, especially through technology development.

Dr. Margaret Dalziel, an associate professor at the University of Ottawa, discussed the evolution of innovation intermediaries in China over the last 30 years. After going over the role of intermediaries in science innovation, she noted that China has made particular use of research institutes, numbering eight thousand at the peak, now down to four thousand. Dalziel also noted the growth of Chinese universities both in size and number. She listed several observations about the Chinese science and innovation system, including that government plays a leading role in fostering innovation; that there is a focus on technology development; and, that "the Chinese approach to innovation . . . is drawing on the legacy of the commune, or the *danwei* —the collocation of work and private life together."

Valerie La Traverse, a science and technology counsellor at the Canadian Embassy in Washington, D.C. who took the place of Kei Koizumi from the White House Office of Science and Technology Policy (OSTP), discussed how science and technology has changed since U.S. President Barack Obama's election victory in late 2008. "In the last eight months, there has been a huge frenzy of activity," she said. After running through the state of American science and technology before Obama, she noted a few of the major changes, including support for the American Competes Act, releasing a memorandum on scientific integrity, large amounts of science spending in the stimulus package, and a speech by the president at the National Academies of Science where he promised to invest three per cent of GDP in research and development. La Traverse identified three priorities for the U.S. government: first, investment in the "building blocks," including education and infrastructure; second, the promotion of competitive markets; and third, catalyzing breakthroughs for national priorities including clean energy and health care. La Traverse also noted some challenges, including whether or not sustained funding would be made available.

Brian Wixted, formerly of the University of Western Sydney, spoke about research networks that bring together stakeholders, researchers, and potential collaborators as an innovative Canadian approach to science and technology. These networks are now being copied in other countries, including Australia, the U.K., and the Nordic countries. "This experiment has sort of taken off as a best practice," he said. Wixted then asked whether or not such research networks work, while admitting the difficulty in evaluating collaborations. He noted some advantages of networks, including bringing together stakeholders to widen the scope of research and more easily allow collaborations between researchers. Networks, he said, seem to work well in countries with large geographies like Canada and Australia, especially in scientific areas of particular strength.

"In the last eight months, there has been a huge frenzy of activity [in Washington.]"

Dr. Sun Yongjian, science and technology consul at the Consulate General of the People's Republic of China in Toronto, gave another perspective on China. He first discussed the main achievements in science and technology in the country over the last 60 years, pointing out the high level of

investment, and going through a brief history of Chinese policy, starting with Mao's march to science between 1950 and 1977, and ending with the 2006 National Medium and Long Term Science and Technology Development Plan. Yongjian also spoke about Chinese systems of policy research, including strategic views of science and soft science research.

Plagiarism is a major problem in China, in part because there is a large amount of pressure to produce measurable work.

During the question and answer period, Dr. Caroline Wagner of George Washington University asked what role culture had to play in the implementation of science policy. Dalziel agreed that culture impacts how we do innovate, but questioned how much it impacts how we can innovate. She expressed doubt that country can depart significantly from its culture to spark innovation. Another participant asked about scientific misconduct. Dalziel noted that plagiarism is a major problem in China, in part because there is a large amount of pressure to produce measurable work. She gave the example that Chinese PhD students must publish an article prior to beginning work on their theses. ■

From L-R: Dr. Alidad Mafinezam, Monali Ray, Dr. Halla Thorsteinsdóttir, Dr. Caroline Wagner, Kevin Fitzgibbons.

SCIENCE DIPLOMACY AND INTERNATIONAL COOPERATION

PANELISTS

Paul Dufour
International Science and Technology advisor at Natural Resources Canada

Dr. Alidad Mafinezam
Co-founder, Mosaic Institute

Monali Ray
Graduate student, University of Toronto

Dr. Halla Thorsteinsdóttir
Associate Professor, Dalla Lana School of Public Health, University of Toronto

Dr. Caroline Wagner
Research Fellow, George Washington University; Research analyst, SRI International

MODERATOR: Kevin Fitzgibbons
Director, Innovation, Science, and Technology, Foreign Affairs and International Trade Canada

Moderator Kevin Fitzgibbons, director of the Innovation, Science, and Technology Division of the Department of Foreign Affairs and International Trade Canada (DFIAT), opened the panel on science diplomacy and international cooperation by noting that some of the most important scientific problems we see in the news—from H1N1 to climate change—are global in nature.

Dr. Caroline Wagner, author of *The Invisible Global College,* argued that the "invisible global college" is the most influential force in science today. Scientists are finding each other through social networks rather than formal institutions. In this respect, science today looks more like it did in the seventeenth century than in the twentieth century, which emphasized national, compartmentalized science institutions. But, Wagner says, science does not exist in a "flat world." Five forces structure the science world: networks; emergence—the idea that order comes not from the top-down but from the bottom-up, as scientists find other scientists with common interests; circulation—the exchange of people and ideas across borders; stickiness—the degree to which research takes place in fixed location (for example, rainforest research can only be done in a rainforest); and, distribution—the extent to which research takes place in many places virtually. Wagner concludes that because "science is a global public good," Canada and the world must move beyond national innovation systems, and worrying about whether, for example, Canada is competing with other countries. Instead, Governments should create incentives for scientists to work with each other across of national boundaries, for the sole goal of advancing science and innovation.

Dr. Alidad Mafinezam, co-founder of the Mosaic Institute, presented on knowledge exchange with the developing world, which he called a "potent and powerful tool . . . in Canada's science diplomacy." He called diasporas—immigrants who have maintained ties to their country of origin—

the “defining issue of our time.” For the first time in human history, highly-qualified workers are migrating in large numbers. Knowledge transfer is successful, Mafinezam argued, when diaspora communities have cultural institutions and a sense of unity that mobilize them in support of their homelands. Canada's open, multicultural policies have allowed diasporas to mobilize here. China, Mafinezam says, “wrote the book.” It maintained databases of diaspora members who could help China and kept in close contact with them. It has also encouraged them to seek the best jobs available to them, whether in China or abroad. This approach has brought at least one benefit: aid sent by its diaspora directly to China amounts to over half of China's overseas aid at $25 billion a year. Mafinezam concluded by arguing that Canada needs to adopt the notion that when people from India and China come here, they are ambassadors for Canada to their homelands as much as they are ambassadors from their homelands to Canada. While such an approach appeared to be emerging while Paul Martin was prime minister, it is “nowhere to be seen now” in the current government's policies.

Dr. Halla Thorsteinsdóttir, associate professor at the University of Toronto's Dalla Lana School of Public Health, presented on Canada's health biotechnology collaboration with developing countries. She argued that Canada's strength in this field—it ranks sixth in the world for health biotech publications and has over 350 health biotech firms—make it an ideal partner for developing countries. Health biotech also helps to solve problems that Canadians, as global citizens, are dedicated to solving. Her study mapped Canadian health biotech partnerships and used interviews to gauge the extent and potential of Canadian health biotech collaboration with developing countries. Thorsteindottir found that about 90 per cent of our research partnerships are with other high-income countries, but that low-income countries' share is growing, though largely because of new partnerships with China. Other developed countries, however, are building a broader range of health biotech partnerships.

Over a quarter of the firms that responded to Thorsteindottir's survey reported collaboration with developing countries, mostly with China and India. Canadian firms saw partnerships as a way to access new markets, carry out research and development, clinical trials, and, in many cases, are developing products jointly with these firms. Canada is a popular international partner for scientists and entrepreneurs, but the Canadian government, Thorsteindottir argued, is not taking advantage of this goodwill. Only nine per cent of health biotech entrepreneurial partnerships were facilitated by government. A lack of funding and little follow up after federal and provincial trade delegations contribute to the problem.

Monali Ray, a graduate student with the Institute of Medical Science and the McLaughlin-Rotman Centre for Global Health at the University of Toronto, presented her research on Canada-India health biotechnology partnerships. For her research, she conducted 53 interviews with Canadian and Indian scientists, firms, and wider institutional actors. Indian interviewees reported that they collaborated to pursue common research interests and take advantage of complementary experience. They benefited from an expanded knowledge base and better graduate student training. But a lack of funding was an obstacle for them, as it hindered student exchanges, which they felt was key to knowledge transfer. Canadian interviewees felt India offered an opportunity to conduct low-cost clinical studies, synthesis and manufacturing, and take advantage of scientific talent. Many Canadian firms set up subsidiaries in India. Their main challenge was finding firms that had a strong record of respect for intellectual property. The impacts of collaboration included increased revenues,

enjoyed by both Canadian and Indian partners, the ability to take on more work, and to offer more services to clients. Ray concluded by noting that Canada's multiculturalism policy and large Indian diaspora make it attractive for Indian scientists, and by echoing Thorsteindottir's call for more funding for international scientific collaboration.

Paul Dufour, International Science and Technology advisor at Natural Resources Canada, argued that engaging in global science improves domestic science programs by applying international standards of excellence, capitalizing on opportunities for international collaboration, and taking advantage of visits, exchanges, and immigration by scientists. Dufour added that while "the world of knowledge is not flat," countries are recognizing that science must be a part of their diplomatic strategies, forging new global science connections. Germany, for example, released an international research strategy in 2008, which aims to intensify cooperation with developing countries in education, research, and development over the long term. Canada, Dufour argued, needs to understand the networks' value in science policy. It also needs to reassess whether existing joint projects are benefiting not only Canada but its partners, that research is becoming more interdisciplinary, and reassess science funding and governance mechanisms.

Dufour called on Canada to hire a chief scientist or science envoy for its Department of Foreign Affairs, noting that the U.S. State Department and the U.K. foreign ministry already have science advisors. He also hoped Canada would do more to mobilize young scientists to build international science linkages through international scholarships, research chairs, and centres of excellence. Dufour cautioned participants against adopting "the arrogance of the new," noting that history can inform current debates recounted at the conference. He referred participants to archived reports by the now-defunct Science Council of Canada, published between 1966 and 1992.

When asked to choose a single initiative the conference should lobby for to Ottawa, Wagner chose the creation of a science envoy; Thorsteindottir and Ray chose increased student exchanges to developing countries; and, Mafinezam chose taking advantage of people's experience in other countries.

During the question and answer period, Dr. David O'Brien asked why "science nationalism" persists. Wagner replied that nationalism spurs competition and is thus an easy way to persuade politicians to boost science budgets. Dufour added that many countries like the U.K. and Finland are moving towards more global science policies. A Carleton University master's student expressed disappointment that panellists did not discuss cooperation with developing countries other than Brazil, India, and China. Thorsteindottir agreed that other developing countries should be discussed more; Mafinezam replied that many of these could be better helped by addressing more urgent problems, like famine and war. The questioner responded that knowledge exchange would help build states' capacities to deal with these problems.

When asked why exchange programs are unstable to the extent that "you make plans in November to apply and you discover in June the program has vanished," Dufour responded that granting agencies have been looking to improve that situation, and that Ottawa plans to release an inventory of activities related to international science and technology cooperation soon. Dr. Eric Archambault of Science-Metrix noted that Canada often poaches the most qualified professionals from developing countries, where they are likely needed most. Wagner replied that historically, expatriate scientists have eventually returned home with better skills and training, citing scientists from Mexico, Chile, and Korea as examples. ■

THE ROAD AHEAD

PANELISTS

Dr. Shiva Amiri
Science and Innovation Officer, U.K. Consulate-General in Toronto

Jeff Anders
Co-founder and CEO, The Mark News

Paul Ledwell
Vice President, Public Policy Forum

Masoud Yeganegi
Master's student, Institute of Biomaterials and Biomedical Engineering, University of Toronto

MODERATOR: Dr. Mehrdad Hariri
Chair, Canadian Science Policy Conference 2009,

Dr. Mehrdad Hariri, chair of the 2009 Canadian Science Policy Conference and postdoctoral fellow a the Mclaughlin-Rotman Centre for Global Health, invited participants to discuss what they felt was the outcome of the conference and what should be its next steps at the closing plenary session.

Dr. Shiva Amiri, science and innovation officer at the U.K. Consulate-General in Toronto, liked that the conference brought together a mix of people from the sciences, media, policy, and industry—and also a mix of different ages; "Experience is important, and fresh ideas are important as well." She stressed that it is important for scientists and policy makers not to ignore each other. Strong public forums, establishing the "do-tanks" Preston Manning proposed in his address, and intelligent involvement from the media can help us do this better. Another issue Amiri heard many participants mention was the lack of PhD students coming out of Canadian universities. She feels students would be more likely to undertake graduate work if they were offered a "stable and clear" career path upon graduation from a doctoral program. Amiri concluded by saying that it's time to

take the onus to produce innovations off universities and let them do research.

Jeff Anders, CEO and co-founder of The Mark, said that many participants told him they want to see the "unrestricted pursuit and advancement of science," and that they want to find new ways to influence policy makers and the public, and to build bridges between science policy stakeholders. Anders noted that a new media revolution is

From L-R: Dr. Shiva Amiri, Jeff Anders, Paul Ledwell, Masoud Yeganegi, Dr. Mehrdad Hariri

allowing experts to bypass journalists—who some participants believe have done a poor job of informing the public about science issues—to talk directly to Canadians. Anders also spoke about The Mark, an online newsmagazine, which brings together "great Canadian thinkers and doers from across all disciplines," chosen not because of their ideology, but because of their professional credibility and their connection to Canada. He noted that The Mark is producing summaries of conference sessions, along with interviews with conference participants, which will be posted online by both The Mark and the Canadian Science Policy Conference.

Paul Ledwell, vice-president of the Public Policy Forum, described his group's Science Day event, which took place May twenty-seventh in Ottawa, and brought together leaders from all sectors. This event will be followed by a series of regional roundtables through February and March 2010 and a second national discussion in Toronto, in May 2010. He said that the Public Policy Forum is looking at how we can build "a culture and a practice of innovation in Canada," and added that there is often a "conflation between innovation and science policy." Ledwell has seen four themes emerge from the Public Policy Forum's consultations: first, the need for a culture change in how scientists deal with policymakers; second, the need for distinct science, technology, and innovation strategies for Canada; third, the need for cross-sector collaboration with a focus on action; and fourth, the need for scientists to better communicate with the public—perhaps by creating a "Canadian association for the advancement of science" and for an online science forum that shares Canadian research and policy ideas.

Masoud Yeganegi, a master's student at the University of Toronto's Faculty of Engineering, relayed some of the online discussion about the conference. He noted that some participants suggested that the onus should be on scientists—rather than government or the media—to educate the public about their work. One Twitter user commented, "Enough about science-illiterate public. What to do about public-illiterate scientists?" Some online discussants felt that the conference didn't have enough academics, though Yeganegi noted that over a third of the conference's 400 participants are academics. Others felt Canada lacks the infrastructure to deal with post-docs. Yenagi suggested that participants might want to consider whether Canada needs more professional skills development programs for graduate students, and whether universities have a responsibility for training their post-docs for careers.

Dr. Elana Brief, a physicist at UBC and president of the Society for Canadian Women in Science and Technology, said that she "loved this conference," adding that "we need many voices and perspectives to make

up a Canadian science policy. I feel very grateful for having my own voice included." She encouraged participants to talk to their colleagues about the conference and seek out people who would be interested in helping develop a Canadian science policy, and send their emails to Hariri.

Dr. Mihaela Ulieru, a Canada Research Chair at the University of New Brunswick, gave a personal example of how new media can foster scientific collaboration. She found out about this conference not through her academic affiliations, but through reading The Mark. One lesson she feels participants can take away from the conference is that, "People are innovative, institutions are not."

A third participant said participants should talk less about having one science "policy" to having many science "policies"—that address federal, provincial, and local governments – and which address the role of government labs, universities, and commercial labs, which often feel disconnected from each other. A future conference could address the dilemma over intellectual property. Another participant hoped that participants would "dare to dream small" by addressing local needs. She wondered whether participants' tasks were to discuss policy for science, or to create policy directions to inform science—as Sweden did when it made a strong commitment to renewable energy.

Mike Padawawa, a freelance journalist, expressed hope that participants would build on the discussions that took place at the conference and engage with the media, and politicians. One participant called on scientists to plan to communicate strategically with people who distrust science and scientists and politicians who feel they can cut science budgets without suffering political consequences. Some participants, including Chuck Black, Secretary of the Canadian Space Commerce Association, felt that participants' chief task after the conference was to discuss solutions and/or take action. Black wondered to what extent the participants would collaborate across sectors on these solutions.

"I think we have the most [science] literate public in the history of civilization."

Dr. Hani Kim, a post-doc at Toronto General Hospital, regretted that the conference never addressed equity, especially with regard to how international scientific partnerships are formed. She hoped future conferences would avoid making "the assumption that promoting the so-called knowledge economy in a particular economic framework will naturally promote public good." Another participant challenged the idea that the public is science-illiterate, saying, "I think we have the most literate public in the history of civilization." He noted that the Perimeter Institute in Waterloo held public, high-level lectures from leading scientists, which were well-received. He concluded that "by thinking the best of the public, they [Perimeter] brought out the best in the public."

Curtis Forbes, a graduate student at the University of Toronto's Institute for the History and Philosophy of Science, stressed that, "Historical studies of science are very important in . . . understanding what science contributes to our society, our culture, our economy," and that it could be helpful to participants as they shape science policy; a graduate public policy student at Carleton University, hoped that scientists would change how they communicate with policy makers by giving them evidence that ministers can understand along the timelines policy makers need to follow.

Hariri closed the conference noting that, "We have created a community of science policy in Canada already," with an online community of over 500 users. ■

SPEAKING NOTES: DR. ALAIN BEAUDET

Introduction

4 areas of focus for presentation:

- What we are doing well, how we compare internationally
- Stay the course and address gaps
- Unique opportunity to build on strengths to bring research into practice
- CIHR's Health Research Roadmap as a response to national challenges.

(1) What Canada is doing well in S & T as it relates to Health Research: Increasing Investment in health research and providing a Return on Investment

- Major increase in public research funding; among the highest GERD/GDP in the industrialized world (but we have no commitment or target to catch up to the best, i.e., over 3% in some countries)
- High impact of publications in health field. The highest in the world in terms of citation of clinical research papers
- High quality research training across the full spectrum of health research
- Science, research and innovation are, today, the only areas capable of producing long-term dividends, such as highly-educated workers, potent new intellectual property and the entrepreneurial means necessary for exploiting this knowledge.
- Knowledge and innovation therefore are not expenditures but investments.
- Cognizant of this, Canada is demonstrating its commitment to Canadian research by making unprecedented investment increases to public research funding. Our GER/GDP ratio continues to improve (at 1.8% still a long way to go to catch up to the world leaders who are above 3%).
- Our strength and our competitive advantage is the quality and breadth of research in universities and research hospital – our HERD/GDP ratio is amongst the highest in the industrialized world.
- I'm also happy to point out that Canada's health research excellence rates high when benchmarked internationally. In fact, it is the highest in the world in the area of clinical research based on citations per paper - a strong indicator of the value-add and quality of Canadian research compared to the rest of the world.
- Just from an economic standpoint, impressive ROI; 40% per year according to recent RAND study sponsored by Wellcome Trust and MRC.
- These above indicators are great but don't tell the full story. Globally, there has been little formal analysis of public health research investments on socio-economic impact (with the exception of US, Australia and the UK, although the metrics used are limited). Earlier this year, the Canadian Academies of Health Sciences released a report that provides the most comprehensive framework for measuring ROI. These metrics are now a vital part of the planning process for establishing a research agenda as well as measuring impacts of health research.
- In my view, all the pieces of the puzzle are now in place so that Canada reaches peak performance in health research and enhances our ROI for Canada`s socio-economic benefit.

(2) Canada must keep building on past efforts and address current knowledge gaps to achieve success

- In order to do so, we need however, to change how we manage and

conduct research in Canada - the status quo is not an option.

- First of all, we must strike better balance between:
  - Research investments (capital, infrastructure, HQP, operations);
  - Basic science and applied research;
  - "Big science" and small, individual or team grants; and
  - Incremental and breakthrough research.
- This will require well-devised multiple streams of approaches to the research process.
- We must also better integrate research and healthcare by putting in place mechanisms that ensure translation of research results from bench to bedside and from bedside to practice (commercialization versus "valorization") and onward to communities.
- For example, CIHR can help improve health outcomes of vulnerable populations that are lagging behind Canadian standards by working with Federal, Provincial, Territories and community representatives including health professionals, Policy/decision-makers, academics, etc. in developing focused strategies and research agendas.
- And we need the high-quality personnel to make this happen. We currently fare poorly in the OECD in terms of PhD output. Our ability to support PDFs is also too limited. And yet, our ability to attract the best and brightest hinges on being able to do so when these young researchers make lifestyle decisions about where to work and establish their research careers. We need to do better on that front.
- And when we train them, we must do so with sensitivity to the needs of all labour markets. Training in research at advanced levels should open doors to careers in public and private sector organizations. Canada cannot hope to be more competitive in global markets without graduates understand these two dimensions: be "globally" skilled to understand and work across cultural divides and "sufficiently "market" savvy to effectively bridge between a research discovery and its translation into application as a new clinical practice, new products, new medicines, new policies, new patents, public understanding, etc.
- Through performance metrics, Canada can determine what works (and what doesn't work) and help us build on success. As mentioned above, we need to use Canada's ROI framework as part of our planning process so we can demonstrate impacts in: (1) Advancing knowledge; (2) building capacity; (3) improving health and health care system; and (4) in contributing to the economy.
- Lastly, although Canada has been a strong presence on the world scene by virtue of its excellent research, we need to assert a greater international leadership. Demographically speaking, Canada is a small country so in order to have greater visible impact internationally; we need to be more focused and strategic. Canada is a choice partner – it can also bring internationally leadership to research into health.

(3) Challenges and Opportunities: Closing the loop from bench to bedside to community back to bench

- The innovative structure of CIHR was a turning point on how Canada conducts research and translates it into application in collaboration with partners. There are 13 institutes and Scientific Director leaders across Canada, and each Institute has an Institute Advisory Board with members also from across Canada.

They are key in helping CIHR set research priorities and informing the research process towards solutions for Canada.

- This structure, however, is just a first step. Canada must take more risk. CIHR can do better in its support of innovative research, multidisciplinarity, and cross-sectoral partnerships.
- But we can't do it alone. In 2000, the legislator had the prescience of mandating CIHR to work with partners at all levels in Canada – CIHR has experimented with various forms of partnerships with different stakeholders over the last 9 years; at this junction, it is particularly critical to actively involve Provinces and Territories early in our strategies forward.
- As our health care system goes through transformation and experimentation in all of our provinces, we have an opportunity to build stronger linkages between research evidence and clinical practice. And in doing so, totally transform how we conduct and deliver care in the country –> Patient-oriented research strategy.
- This strategy will capitalize on Canadian unique strengths: a high-quality universal health care system, good databases, our ability to deliver quality, efficacious, and speedy recruitment of candidates for clinical trials. These are key to our ability to re-capture an eroding competitive edge and compete with emerging nations such as China and India which can offer numbers and costs we simply cannot measure with.

(4) CIHR's roadmap: A journey towards solutions with our partners

- CIHR has just released its Strategic Plan for the next 5 years. The plan tries to address some of the challenges identified today. It is a first step in engaging our private and public sector partners early in the discussion and in the research process.
- As part of our plan, we identify 4 strategic directions to address health challenges:
  - Invest in World-Class Excellence
  - Set Health and Health System Research Priorities
  - Accelerate the Capture of Health and Economic Benefits of Health Research
  - Achieve Organizational Excellence, Foster a Culture of Ethics and Demonstrate Impact
- For example, one of the strategic directions is to address health and health system research priorities. Under this strategic direction, in consultation with various stakeholders, 5 overarching priorities were identified. These are to:
  - Enhance patient-oriented care and improve clinical results through scientific and technological innovations;
  - Support a high-quality, accessible and sustainable health-care system;
  - Reduce health inequities of Aboriginal peoples and other vulnerable populations;
  - Prepare for and respond to existing and emerging threats to health;
  - Promote health and reduce the burden of chronic diseases and mental illness.
- No doubt we will need to work with our provincial and territorial colleagues on these ambitious priorities to further develop the research elements under each.
- On the international front, the plan proposes to continue to pursue opportunities for Canada and provide support for Canadian researchers to become global leaders. ■

SPEAKING NOTES: PRESTON MANNING, CC

"Responding to Canada's Science Policy Challenges"

Introduction

- Thanks for the opportunity.
- Congratulations to the organizers and sponsors.
- Have noted the credentials of speakers and participants – very impressive, intimidating.
- My own credentials rather modest. But should tell you where I'm coming from.
  - Did my university work at University of Alberta – motto is "whatsoever things are true."
  - Began my pursuit of truth by studying physics
  - Couldn't handle the math so went into economics
  - Then eventually went into politics, obviously abandoning the pursuit of truth altogether

Subject

So, having thoroughly impressed you with my scientific and truth-telling credentials, I would now like to address the subject of "Responding to Canada's Science Policy Challenges" – with the emphasis on *responding*.

In particular, I would like to propose some specific responses to three priority challenges of special concern to me (and hopefully to you):

- Challenge of increasing the number and quality of science-receptive people at the political level.
- Challenge of raising the strategic and financial commitment to research and development on the part of Canada's private sector.
- Challenge of bridging the communications gap between the scientific and political communities.

I. First challenge: Increasing the number and quality of science-receptive people at the political level

If you want a stronger and better-informed response to science policy proposals (for example, the proposals that may come from this conference) at the political level, you need people there – among the elected Members and their senior political staff – with a science interest and orientation, political receptors who are receptive to scientific and science-policy messages.

The sad fact in Canada is that we simply don't have them:

- Very few members of the House of Commons and Senate (fewer than ten?), provincial legislatures, with any kind of science background.
- Even fewer people among their senior political staff.

This is reflected in:

- The very nominal and cursory attention given to STI policy in party platforms.
- The infrequent references to science in political speeches, and the superficiality of what references there are (twenty sports analogies to every one science analogy).

All this notwithstanding the fact that an increasing number of public-policy issues (environmental issues, health issues like H1N1, knowledge economy issues) have a large scientific dimension.

So, what to do?

Two suggestions:

(1) Encourage each of the major political

parties to recruit a small number of science-oriented candidates to stand for election, and assist the parties to do so by providing them with the names of possible nominees. Don't be afraid of the partisanship of it all. Real political world/Parliament/ministers' offices are partisan. Recognize/work with it, as law firms do, working "both sides of the political street."

- We're not expecting a budding young scientist to give up his or her career in mid-stream to go into politics. But can we not find some former science administrators, or people who have studied science policy and communication, to make themselves available – with the support of colleagues – for 4-8 years for public service in this capacity?
- *Note*: I should mention that the organization that I now head, the Manning Centre for Building Democracy (www.manningcentre.ca), is committed to providing training to people, particularly younger people, who want to get into the political field. And if you or some science body were to provide us with a list of potential science-oriented candidates for public office, we would make it our business to arrange mentoring and training programs for them, if that would be helpful. (Much rather try to add political knowledge and skills to a science oriented person, than to add scientific knowledge and skills to an old-school political person.)

(2) Second suggestions, establish a Parliamentary Office of Science and Technology in our Parliament, similar to that established in the Parliament of Great Britain.

- When I was in Parliament, we tried to get the Government to establish the Office of the Scientist General – an officer of Parliament similar in status to the Auditor General – who would not personally try to advise Members of Parliament on science issues but would put them in touch with scientific advice sources.
- Eventually the Government did appoint a Science Advisor, but he was attached to the Executive, not to the Parliament, and the office was allowed to languish under Mr. Martin and then replaced by the Science, Technology, and Innovation Council under Mr. Harper.
- The British have successfully established their POST (Parliamentary Office of Science and Technology) and I believe that Canada should do the same. Primary output is POST Notes, advice to MPs/Committees, seminars.

II. Second challenge: Raising the strategic and financial commitment to research and development on the part of Canada's private sector

This is an old, old problem which was highlighted yet again in a recent study by the Council of Canadian Academies' Expert Panel on Business Innovation:

- Business R&D in Canada as a percentage of GDP declined 20% between 2001 and 2007, and has consistently fallen below the OECD average.
- Challenge of addressing the problem is compounded by the fact that over the last four decades Canadian business on average has been slightly more profitable than our American counterparts, despite this low level of R&D and lower productivity.
- All of which suggests that the incentives and conditions facing Canadian businesses are simply not conducive to increased R&D and that you won't change their behaviour simply by preaching at Canadian business but rather by changing the incentives and the conditions of the business and political environment in which they operate – something that requires changes in both public and private STI policies and innovation strategies.

So, what to do?

I've been a member of a small ad hoc group that has been addressing this question for the last two years and one of the conclusions we have come to is that Canada needs a strong, private-sector-based, not-for-profit, non-partisan think tank/do tank to focus on this problem, particularly from a private sector perspective. This country has numerous think tanks/do tanks dealing economic policy, social policy, environmental policy, but not in the area of STI policy.

- We therefore developed a proposal for a *Centre for Innovation and Prosperity* which would perform four functions:
  - Push STI policy recommendations with government, aimed specifically at changing the incentives and conditions that inhibit R&D by Canadian business.
  - Push Canadian business to adopt complementary innovation strategies, on the theory that government will respond to private-sector proposals if the private sector itself is taking complementary actions and not just calling upon the Government to "do something."
  - Follow up on the numerous recommendations that have been made by government-sponsored task forces over the last several years in this area but which languish for lack of persistent follow-up capability.
  - At the same time, provide services to address the communications gap that exists between the scientific community, the business community, and the political community (more on this later) – communications gaps which constantly inhibit collective understanding and initiatives.
- We are currently in the process of attempting to secure private-sector funding for this *Centre for Innovation and Prosperity* and if you're interested in monitoring our progress or influencing the shape and functions of this organization – to increase private-sector commitment to R&D – please give me your card after this luncheon or e-mail me at pmanning@mcbd.ca.

III. Third challenge: Bridging the communications gap between the scientific and political communities

I don't believe that the scientific community has begun to appreciate the extent to which communications utterly dominates the political arena, the political mind, and the participants in electoral politics.

To illustrate: If a contemporary caucus or cabinet committee or elected member cannot see within about 90 seconds how to communicate through the media to the public the position you are trying to get them to take (say, for example, on science policy), that position is in difficulty no matter what its scientific, administrative, economic, social, or other merits may be.

This is because the politician is sitting there thinking:

- If we adopt that position, how will I explain that to the television reporter who is waiting outside this room when she sticks her mike and her camera in my face?
- If we adopt that position, how will I explain that at the town hall meeting back home next Saturday night?

For example, the head of one of Canada's science agencies told me about making a pitch for support of his agency to a Cabinet Minister just before the finalization of the Budget. The Minister's first question was, "How would you explain that to the cab driver who just brought you to my office?"

What that politician is doing initially is judging the policy position or the action we are trying to get him or her to take – not first and foremost on its policy or scientific merits, not on its economic or administrative feasibility, not on its constitutionality or even its morality, but on

its communicability through the media to the public.

And if we can't satisfy these concerns about communicability at the front end, within about ninety seconds – by showing right then and there how our position can be communicated, by putting it in its politically communicable form – our position is in trouble with that caucus member regardless of all its other merits. The inability of this country to have meaningful public/political debate on health care reform or global warming or any other science-based issue is rooted to a very large extent in the inability/unwillingness of policy proposers to address this challenge.

Once you do demonstrate that what you are advocating *is* politically communicable, *then* you can get that minister, cabinet committee, or caucus to concentrate on its other merits and features, including the scientific and substantive arguments on which it is based.

Some of you need to develop and practise this skill – putting science messages in their politically communicable form – especially if your most usual form of communication is through the writing of technical papers and grant applications, or making technical presentations.

Story of MPs' Visit to Chalk River to discuss Neutron Reactor

Scientists with Atomic Energy of Canada wanted to get political support for building an advanced neutron reactor.

I persuaded a small group of MPs to accompany me to AEC's Chalk River facility for a presentation by a very reputable nuclear physicist.

Here was the presentation from the science perspective: Physics 101 (what is a neutron? what is a reactor? what is a neutron beam?, etc.); then the potential applications (we can use the neutron beam to examine the molecular structure of this and that, and oh, by the way, here is a piece of an O-ring from a Saturn vehicle like the one that blew up); then the Case for the Neutron Generator.

How would I have reorganized that presentation to a political audience? Begin with stress – material *stress* (examples, Saturn vehicle blowing up, bridge collapsing, Firestone tire exploding, hockey stick breaking on a crucial slap shot, etc.). Lesson? This kind of stress *costs*, material stress loses hockey games, material stress kills, etc. So, what is this stress? Molecules that should hang together, de-coupling. How can we understand it better? Reduce stress fractures? Develop stronger materials? *Now*, Physics 101, how a neutron beam can be used to study stress; and then, the case for the Neutron Generator.

The physicist making that presentation needed help in putting his science message into a politically communicable form. But where is that help going to come from? And from whom would such a learned scientist take advice on communications? (I will return to this in a moment).

So, what to do?

- Appreciate the difference between receiver-oriented and source-oriented communicators. Scientific people tend to be source-oriented while democratic politicians are receiver-oriented. If you're the initiator of the communication, obligation is on you to adjust to the orientation of the receiver.
- Secure the services of people who understand the political mind-set and can assist the scientist or technologist, or science policy advocate to translate their messages into their politically communicable form.

One further suggestion: I know scientists are skeptical, sometimes with good reason, of PR and communications types. But there are people in Canada and around the world who specialize in the *science* of communication: psychologists who study how an idea gets from one person's head to another's; electronics engineers who understand signal generation, transmission, distortion, amplification, and reception; anthropologists and sociologists who

understand cross-cultural communications, etc.

In other words, there is a *science* of how a signal, a word, an idea, a concept, a fact, an emotion, a policy proposal can be transmitted effectively from one person's head to another to trigger a desired response.

I would therefore like to propose that someone somewhere – perhaps a science funding agency or a scientific association such as yourselves – launch a project and hold a conference to thoroughly examine the Application of the Science of Communication to the Communication of Science.

Conclusion

So, to summarize, three challenges which I believe the science policy community needs to address:

- Increase the number and quality of science-receptive people at the political level.
- Raise the strategic and financial commitment to research and development on the part of Canada's private sector.
- Bridge the communications gap between the political and scientific communities.

Some suggestions for responding to these challenges:

- Recruit science-oriented people into public life.
- Establish a Parliamentary Office of Science and Technology.
- Establish a Centre for Innovation and Prosperity to raise the private sector's commitment to R&D.
- Understand the difference between receiver-oriented and source-oriented communicators.
- Acquire the services of those who can translate science messages into their politically communicable form.
- Hold a conference and form a working group to examine the application of the science of communication to the communication of science.

Finally, I deliberately titled my remarks to emphasize *responding* to priority science policy challenges, whatever those may be.

I have spoken at dozens of conferences and meetings over the years that have wrestled with the various challenges you are dealing with. And one of my fears is that we Canadians are succumbing to what might be called "discussion-itis" where we substitute *discussion*, analysis, presentations, the preparation of papers, the framing of resolutions, etc., for *action* or the creation of pressure to induce others to *act* on the results of our discussions.

What I would suggest, therefore, is that the organizers of this Conference take whatever they consider the best suggestion or proposal from this Conference to be, develop an *Action Plan* for securing the implementation of that suggestion or proposal, and pursue that Action Plan until the recommendation it embodies is either accepted and implemented or flatly rejected.

You will learn more about how to advance science policy proposals by pushing one such proposal "all the way down the pipe" than you will by simply stuffing forty proposals into one end of the pipe.

My plea is for us to "do something" rather than endlessly analyze and discuss, and that we ultimately judge the success or failure of our collective efforts to advance science policy on the national agenda by the actions that are taken to bring about that result. ■

SPEAKING NOTES: DR. PETER NICHOLSON

"From Resource-Based to Knowledge-Driven: The Importance of Business Innovation"

The productivity of Canada's business sector has been falling behind that of the U.S. since the early to mid-1980s. The relative decline has been from 93% of U.S. business productivity (output per hour) in 1984 to about 75% currently.

• The reasons for the relative decline are not entirely well-understood but it appears largely due to the more effective exploitation of the information and communications technology by U.S. business – particularly by SMEs.

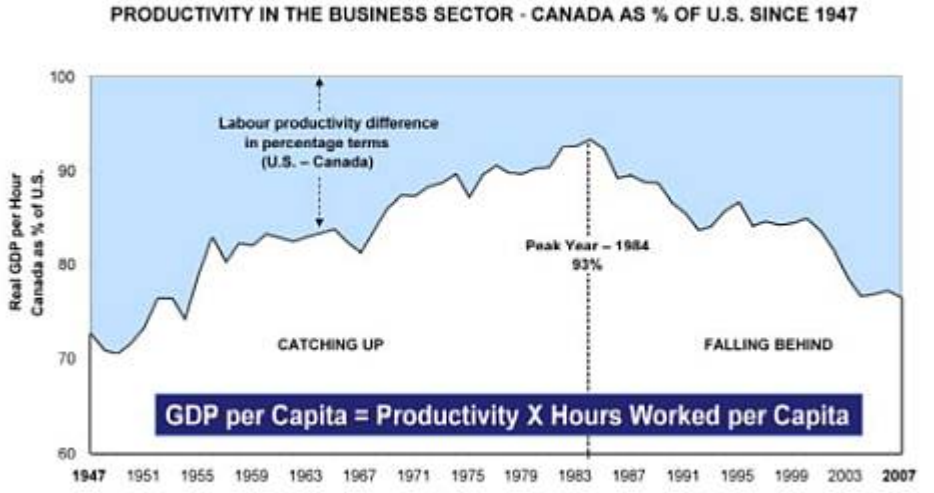
• Canada is a productivity laggard not only relative to the U.S. Canada's business productivity growth rate, averaged over the period 1985-2006, ranked 15th out of 18 OECD comparator countries.

• Since Canada's labour force utilization has been relatively high – and demographic factors will tend to create labour shortages in the medium to longer term – increases in GDP per capita will increasingly have to be driven by productivity growth , not by employment growth.

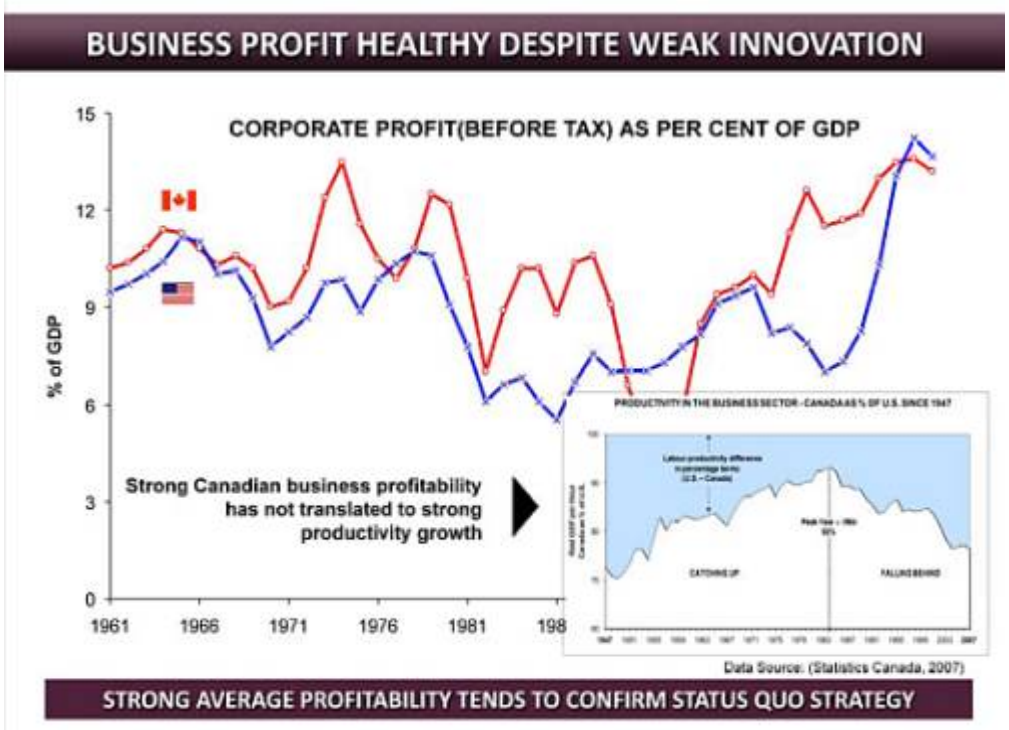
• Analysis by Statistics Canada of the factors principally responsible for productivity growth – i.e., increasing capital intensity; improvements in the education and experience of the workforce; and a residual called "multifactor productivity" (MFP) – shows that Canada's comparative productivity weakness is due to persistently lagging MFP growth.

• The average rate of MFP growth over long periods is a good statistical indicator of innovation, broadly understood to include not only application of science and technology but also better business models and more efficient processes of all kinds. Canada's weak rate of MFP growth over a very long period suggests that this country's productivity problem is really a business innovation problem.

CANADA'S RELATIVE PRODUCTIVITY SLIDE



WEAK PRODUCTIVITY GROWTH IS DUE TO SUB-PAR BUSINESS INNOVATION



• The question is why Canadian businesses,

on average (though with some significant exceptions), have not emphasized innovation in their strategies. The situation has persisted for decades and must therefore have deep structural roots.

• Two fundamental and long-standing characteristics of the economy are key:
• **Small Market:** Canada is a relatively small and fragmented domestic market and thus lacks the scale to offset the risk of upfront investment (in R&D, leading-edge equipment, or major changes in business practices) that innovation-based strategies

typically require. Small markets are also less attractive to leading-edge competitors and thus tend to exhibit less competitive intensity and less pressure on domestic firms to innovate to survive.

• **Upstream Role:** Many Canadian industries occupy "upstream" roles – i.e., at the commoditized end – of integrated North American value-chains, and are thus separated from direct contact with ultimate end customers. Understanding and meeting the needs of the end customer (as opposed to an intermediate supplier) is frequently the motivation for innovation-focused business strategies.

• Many Canadian suppliers of intermediate goods and services or manufacturers/assemblers linked
to foreign multinationals have world-class plants skilled in incremental innovation to achieve continuous operating efficiency improvement.

• It is emphasized that a small domestic market does not necessarily discourage businesses from adopting innovation-focused strategies – e.g., as the examples of Switzerland, Finland and Sweden amply demonstrate. But those small-market countries that have become globally successful innovators have done so by developing export markets for sophisticated products, often targeted to the "end customer".

• Canada's generally weak business innovation performance has not led to poor profitability overall. In more than 80% of the years since 1961, (pre-tax) business profit in Canada, expressed as a percent of GDP, has exceeded the comparable measure in the

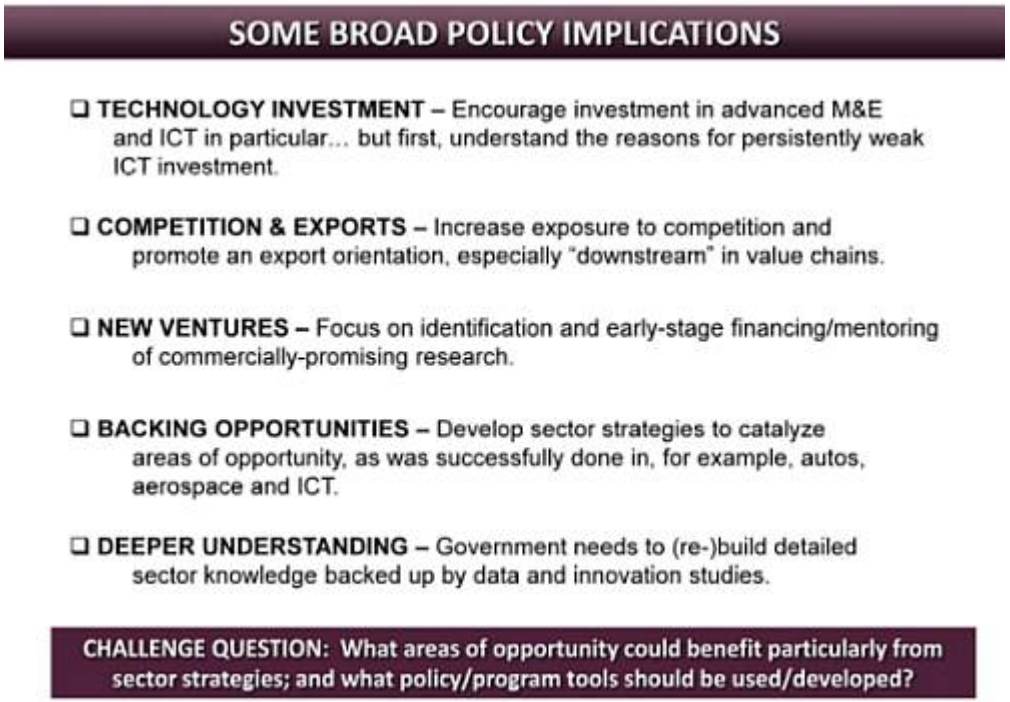
US.

• The reasons for Canada's generally higher profitability ratio do not appear to have been well analyzed. Although movements in the exchange rate may account for some of the greater volatility of business profit in Canada, this does not appear to explain the higher average level over the past 45 years. Less vigorous competition in Canada's domestic market may be a significant contributor.

• Regardless of the reasons for comparatively strong profitability, the fact remains that Canadian businesses, on average, have not been under much pressure to change fundamentally their traditional strategies – why quarrel with success?

• Although business profitability has been healthy despite relatively weak innovation performance, Canada's overall productivity growth has been exceptionally weak since the early 1980s, and this has been primarily due to weak business innovation.

• But as long as the circumstances in which Canadian businesses operate continue to yield good profitability, business strategy will not change very much. Therefore, if Canadian businesses are to become significantly more innovative, it will only be in response to a significantly changed business environment.



• Looking beyond the current global downturn, there are four major changes under way in the environment in which Canadian business operates.

• **First** – Unimpeded access to the US market is increasingly at risk as a result of: (i) a drift toward increased protectionism, principally in response to strong competitors in emerging markets, notably China; and (ii) the constant risk of another major terrorist attack on the US in the wake of which we would expect a much "thicker" border.

• **Second** – Offsetting the growing vulnerability of access to the US market are the tremendous opportunities in growing markets, particularly in Asia. Though there is heavy demand for Canadian resource-based products in these markets, the greater opportunity lies ultimately in sophisticated goods and services, the production of which will require a commitment to innovation by Canadian businesses.

• **Third** – Resources will always be important for Canada, but they are too volatile and unevenly distributed to be the major sustainer of national prosperity in the longer term. Moreover, resource production will have to become even more knowledge-intensive in order to minimize environmental impact and to develop new supplies cost-efficiently. Canada should also be providing more capital goods and services, including software, to resource industries both at home and abroad.

• **Finally** – The demographics of Canada's business people are changing as new cohorts that are more at home in the world – in many cases, first or second generation new Canadians – rise to positions of leadership. This new generation will be less captive of old mind-sets and more willing to embrace innovation strategies to seize opportunities in global markets.

• **Taken together, these changed conditions are creating powerful new incentives for Canadian businesses to adopt more innovation-focused strategies.**

• New factors in the competitive business environment will be by far the strongest motivators of a strategic re-orientation of

Canadian businesses toward innovation. Without a strong push from the (global) market, there is little that public policy, by itself, can do to create a more innovative Canadian business sector.

• But given the new market realities outlined earlier, there is an important role for supportive public policies. The five broad themes indicated above should build on an existing directions characterized by:

• Strong support for university research and training as well as "4th Pillar" organizations like CANARIE, CMC, Precarn, the Centres of Excellence, among others.

• Considerable skepticism (some of it well-founded) developed over the past three decades as to the effectiveness of government-supported sector strategies. The view that there should be little or no role for sector policies (i.e., "government should not try to pick winners") is too simplistic. Government microeconomic interventions can be effective under some circumstances if they are well-designed and implemented as intended – e.g., without political override. The challenge is to identify a small number of genuine opportunities that could benefit from properly designed and targeted public policies and programs. ■

SPEAKING NOTES: DR. PETER SINGER

Good morning everyone!

Let me just say what a pleasure it is to join my colleagues on this panel - Heather, who is doing such outstanding work on the Science Technology and Innovation Council to promote internationalism in science and to benchmark Canada against the best; Alain, leading the CIHR in important international work, including with the Gates Foundation on its Grand Challenges in Global Health; and Chris, whose University Health Network is overseeing such exciting research, including in the areas of cancer stem cells, at the Princess Margaret Hospital - and with an outpost in Shanghai.

And, of course, all ably chaired by Dr. Gabriel, Assistant Deputy Minister for Ontario's Ministry of Research and Innovation, which is doing really creative work in bringing an evidence-based policy framework for research and innovation across government.

So it's a real honour to share this panel with them and this time with all of you.
I want to begin by congratulating Dr. Hariri and the other members the organizing committee for pulling together such a first rate Conference! Perhaps one of the most important conferences any of us will attend this year. Why?

Because its fundamental premise - that science and innovation are essential to the future of Canada, our prosperity and our foreign policy - is one that I think needs to be better understood across society.
We live in a time when science and innovation are re-shaping our world as never before. When research and discovery hold the key to issues as diverse as global health, climate change and food security.

Today, I'd like to examine how science policy can be projected internationally to address some of the fundamental global challenges - and why it is so important that we make this international agenda a priority in our national Science and Technology Strategy. My focus will not be the usual suspects - the U.S., the E.U. or Japan - but on the emerging and developing world.

You know it's been almost fifty years since Lester Pearson won a Nobel Peace Prize for his role in resolving the Suez crisis. Pearson's proposal - the creation of peace keeping forces wearing the blue helmets of the United Nations - revolutionized international relations, revitalized the U.N. and cemented Canada's reputation in global affairs. It was a time when Canada's foreign policy mattered. To us. And to the world.

I believe it's time for Canadian foreign policy to matter again. It's time to propose a new vision, one that will contribute to building a better, safer world. Just as this country formulated a new way to address global conflict through peacekeeping, today we have the opportunity to address global challenges through science. And, in the process, create a compelling new brand for our foreign policy.

Nor is this simply a humanitarian exercise, important as that is. It's also a commercial exercise that will benefit Canadians.

So what would our brand be? That Canada - and Canadian scientists - help solve global challenges. We do so both directly and by fostering innovation in developing countries. This would be a unique niche for our country, one in which

we lead the way and inspire others to follow.

Think of it as expanding beyond blue helmets to white lab coats. Or, as Francis Collins recently described global health, "the chance to be more of a doctor to the world than a soldier to the world."
Solutions to global health, food security, energy and climate change all require advances in science and technology. We live in a world where 10 million children die before their 5th birthday, more than a billion people go hungry every day, extreme weather events are devastating communities.

Can science help address these global challenges? Absolutely! Just look at malaria - a disease that kills one million children in Africa every year and for which there is currently no vaccine. Today? We have three malaria vaccine candidates in the pipeline. Think of what a successful vaccine for malaria would mean to the world!

And HIV/AIDS. Just a month ago, we had tantalizing results in the Thai Prime Boost Trial - the first indication that a vaccine for HIV might work.

Staple crops like cassava, sorghum, rice and bananas that are loaded with micronutrients - iron, vitamin A and zinc - all critical to human health but so often missing from the diet of the poor.

And we are well on the way to developing a drought tolerant maize for Africa, so important in a year when drought has ravaged East Africa.

So science is delivering results and there are tremendous opportunities to make a difference. The point I would make today is that those opportunities hold the key not only to the progress of developing countries, but to our own prosperity here in Canada.

The fact is that with a relatively small domestic market and an over-reliance on the U.S., largely built on a weaker dollar, we simply have to be more outward looking. And emerging economies, like India, China and Brazil, represent the fastest growing markets for Canadian life sciences technologies, knowledge and products. So the potential for Canadian businesses is enormous.

What's critical is that our entrepreneurs understand the challenges these markets face.

It means understanding not only the "push" of what we have to offer, but also the "pull" of what each country needs. If our entrepreneurs recognize the unique challenges that must be met - and the opportunity such challenges provide - they can be enormously successful in these burgeoning new markets.

What we need to do is find a way of matching Canadian companies to partners in emerging countries.

Well, you may say, sounds good in theory. But does Canada really have what it takes to develop a distinctive new priority for its foreign policy - one based in science and driven by innovation? Can we match our actions with our ambition? The answer is absolutely!

In fact, much of the infrastructure is already in place. We have the International Development Research Centre, created in 1970 to help developing countries use science and technology to find "practical, long-term solutions to the …problems they face."

We have the Global Health Research

Initiative, a partnership among the Canadian Institutes of Health Research, Public Health Agency of Canada, and Health Canada, and IDRC and the Canadian International Development Agency, which does twinning between Canadian and developing world scientists.
We also have world class universities that could become involved not only through collaborative research, but also by harnessing the incredible energy and enthusiasm of Canadian youth to address global problems. I am amazed, impressed - and inspired - by the ingenuity, energy, commitment and creativity of today's students in wanting to help solve global problems. Anybody that says campus idealism died in the 1960s isn't visiting Canadian campuses! Students are just looking for an outlet for their idealism - and branding Canadian foreign policy as helping developing countries through science and innovation answers that need.
Canada has signed Science and Technology Agreements with both China and India, as well as a Framework Agreement for Cooperation on Science, Technology and Innovation with Brazil.

And International Science and Technology Partnerships Canada (ISTP) is funding joint projects between Canadian and Indian and Canadian and Chinese scientists.

Another important asset for Canada is our Diaspora. Canada is home to more than 15,000 scientific and health-related professionals from developing countries.
Many of these still have family there. Ties. Connections. And these linkages provide a unique opportunity to expand our scientific and trade networks, while at the same time enabling our scientists and engineers to give back to the nations which they have come from.

And very significantly, we have the new Development Innovation Fund. In the 2008 federal Budget, the Government announced $50 million for the creation of the Development Innovation Fund which would, and I quote, "create breakthrough discoveries with the potential to significantly improve the lives of millions in the developing world." end quote.
So there's simply no doubt that Canada has what it takes to project science and innovation internationally to help solve global challenges - and to foster innovation in developing countries. To expand beyond blue helmets to white lab coats.

Let me just quickly suggest five reasons for doing so.

First, Canada will help solve important problems plaguing five billion people in the developing world. And, in the process, address one of the most critical issues of our times - the disparities in health and well-being between the rich and poor countries. Why is it acceptable that a child born in Canada – like my own daughters – will live to 80 years of age, while a child born in many parts of sub-Saharan Africa will only live to age 40?

Second, Canada will develop solutions that will benefit us domestically, especially with respect to shared threats such as H1N1, climate change and chronic disease. Some of these solutions will apply to Canada's Aboriginal communities. Indeed, addressing the challenges of our own Aboriginal population will reinforce our credibility as a country that helps developing communities abroad by also addressing needs at home.

Third, developing a brand related to innovation, while it may begin with development, will also reinforce trade relations in innovative sectors, helping to market Canadian companies abroad.

You know, it used to be that emerging economies were rather dismissively labelled as "the rest of the world" in pharmaceutical circles. Well guess what? The "rest of the world" has most of the people, most of the health problems and most of the economic growth. Even in the face of the current economic slowdown, China is expected to grow between seven and eight per cent this year. India, between six and seven.

Countries - and companies - that engage with these markets will prosper and gain comparative advantage. So today, "the rest of the world" *is* the world. And if Canadian companies are not in Shanghai, Mumbai or Dubai, they're missing out on the greatest commercial opportunities of our time.

Fourth, by helping countries solve problems with science, we help them to develop, to raise their living standards. Stated another way, the best way to keep countries poor is to make sure that they don't develop their own talent. That they don't turn their own domestic ideas into products and services. Canada can help countries escape that trap. For example, why not create a centre in a region like sub-Saharan Africa to connect scientists and entrepreneurs, similar to the MaRS Discovery District in Toronto.

Fifth, science fosters diplomacy. A friend of mine, who was an American Colonel involved in negotiations with the Soviets on issues of biosecurity, told me that often, when the diplomats reached an impasse, it was scientists, on both sides, who broke through. That's because they spoke a common language. The language of science. Perhaps the only universal language.

So what should we do? The upcoming meetings of the G8 and G20 in Muskoka next summer provide important opportunities to shape the agenda. Exercise leadership. And set us on a new course.

At a time when the G20 is emerging as the new institution for global governance - when power is shifting from the West to a more global community - Canada needs to redefine its role. Re-establish its relevance. Canada should raise the role of science and innovation, showcase the Development Innovation Fund and invite other nations to develop similar initiatives.
Imagine what could happen if every international development agency also funded science. Think of what that could mean to global health. To food and energy security. To climate change and the environment. To the creation of a safer and more equitable world.

Think of what projecting our science and technology internationally could mean to Canadian businesses. To companies wanting to reach new customers. To entrepreneurs seeking new partners. Developing new markets. Increasing trade. Creating more jobs for Canadians.

So for Canada, expanding beyond blue helmets to white lab coats brings significant benefits - to brand our foreign policy based on helping others through science. Solving big problems. Driving Canadian innovation. Opening new markets. Helping countries to develop. Promoting diplomacy. And carving a niche for ourselves in the emerging G20.

Canada is not a country of small dreams. Modest ambition. Limited vision. The proposal I have made today builds on our strengths, honours our past and points us to a larger - and better - future.
Around the same time that Lester Pearson won that Nobel Peace Prize, there was another significant event in this country -

the cancellation of the Avro Arrow. Whatever the reasons behind that decision, there is no question that it is now remembered as an opportunity lost, as a time when the genius of our people was not matched by our vision.

Let's not make the same mistake, fifty years later. Let's seize this moment, this unique confluence of Canadian expertise and international need to project Canadian science and innovation internationally to help solve global challenges.

It's just the kind of marriage between science and public policy that this conference envisions and these times demand.

Thank you. ■

SPEAKER BIOGRAPHIES AND ABSTRACTS

Keynote Speakers

Bruce Alberts, PhD

Bruce Alberts, a prominent biochemist with a strong commitment to the improvement of science education, began service as Editor-in-Chief of Science on March 1, 2008. Alberts is also a professor in the department of biochemistry and biophysics at the University of California, San Francisco, a position he returned to in 2005 after serving two six-year terms as the president of the National Academy of Sciences (NAS) in Washington, D.C.

During his tenure at the NAS, Alberts was instrumental in developing the landmark National Science Education standards that have been implemented in school systems nationwide. The type of "science as inquiry" teaching we need, says Alberts, emphasizes "logical, hands-on problem solving, and it insists on having evidence for claims that can be confirmed by others. It requires work in cooperative groups, where those with different types of talents can discover them – developing self confidence and an ability to communicate effectively with others."

Alberts is also noted as one of the original authors of The Molecular Biology of the Cell, a pre-eminent textbook in the field now in its fifth edition. For the period 2000 to 2009, he serves as the co-chair of the InterAcademy Council, a new organization in Amsterdam governed by the presidents of 15 national academies of sciences and established to provide scientific advice to the world.

Committed in his international work to the promotion of the "creativity, openness and tolerance that are inherent to science," Alberts believes that "scientists all around the world must now band together to help create more rational, scientifically-based societies that find dogmatism intolerable."

Widely recognized for his work in the fields of biochemistry and molecular biology, Alberts has earned many honors and awards, including 15 honorary degrees. He currently serves on the advisory boards of more than 25 non-profit institutions, including the Gordon and Betty Moore Foundation, and the Lawrence Berkeley National Laboratory.

Hon. Gary Goodyear, MP

Gary Goodyear was first elected to the House of Commons in 2004 and was re-elected in 2006 and 2008. On October 30, 2008, he was appointed Minister of State for Science and Technology, and on August 13, 2009, he was named Minister of State responsible for the Federal Economic Development Agency for Southern Ontario (FedDev Ontario) by Prime Minister Stephen Harper. Prior to entering federal politics, he practised chiropractic medicine and worked as an advisor to investment firms in the biomedical industry.

A former Public Relations Director and Past President of the College of Chiropractic Sports Sciences in Toronto, Dr. Goodyear taught at Canadian Memorial Chiropractic College and the University of Waterloo. He was co-designer of a three-year post-graduate sports fellowship program and co-author of "Practice Guidelines." He has worked with many athletes, both amateur and professional, and served as medical services chair of the Ontario Special Olympics.

Dr. Goodyear attended the University of Waterloo, specializing in kinesiology and

psychology, before graduating from Canadian Memorial Chiropractic College. He worked his way through university as a meat packer and labourer.

A native of Cambridge, Ontario he is married to Valerie and they have two children. He enjoys scuba diving, writing and rebuilding motorcycles.

Preston Manning, C.C.

Mr. Manning served as a Member of the Canadian Parliament from 1993 to 2001. He founded two new political parties – the Reform Party of Canada and the Canadian Reform Conservative Alliance – both of which became the official Opposition in the Canadian Parliament. Mr. Manning served as Leader of the Opposition from 1997 to 2000 and was also his party's critic for Science and Technology. In 2007 he was made a Companion of the Order of Canada.

Since retirement from Parliament in 2002, Mr. Manning has released a book entitled Think Big (published by McClelland & Stewart) describing his use of the tools and institutions of democracy to change Canada's national agenda. He has also served as a Senior Fellow of the Canada West Foundation and as a Distinguished Visitor at the University of Calgary and University of Toronto. He is a member of the Institute of Corporate Directors and is an Institute Certified Corporate Director.

Mr. Manning is currently a Senior Fellow of the Fraser Institute and President and CEO of the Manning Centre for Building Democracy. The Manning Centre (www.manningcentre.ca) is a national not-for-profit organization supporting research, educational, and communications initiatives designed to achieve a more democratic society in Canada guided by conservative principles.

Mr. Manning is married to Sandra. They have five children and nine grandchildren.

Mr. Manning continues to write, speak, and teach on a variety of subjects including the revitalization of democracy and Canadian conservatism, strengthening relations between the scientific and political communities, the application of market mechanisms to environmental conservation, and the management of the interface between faith and politics.

Hon. John Milloy, MPP

The Hon. John Milloy was first elected Member of Provincial Parliament for Kitchener Centre in 2003. He was re-elected in 2007 and appointed Minister of Training, Colleges and Universities on October 30, 2007.

John's political interest began at age 13 when he worked as a Queen's Park page and continued as he worked in political offices at both the provincial and federal level. From 1997 to 2002, John served as Legislative Assistant to Prime Minister Jean Chretien.

In his first term as MPP, John held the position of Parliamentary Assistant to the Minister of Intergovernmental Affairs and to the Minister of Training, Colleges and Universities. He also served as Chair of the Federal Interprovincial Municipal Relations Cabinet Committee. In November, 2007, he was appointed to the provincial government's anti-poverty committee.

John holds a BA (Honours) in History from Carleton University, a Master's degree from the London School of Economics and a doctorate in Modern History from the University of Oxford where he was a Commonwealth Scholar.

John is past Director of Public Affairs for the Centre for International Governance Innovation in Kitchener-Waterloo. He has written on both international history and governance in the information age, recently publishing The North Atlantic Treaty

Organization, 1948-1957: Community or Alliance.

John and his wife, physician Dr. Sara Pendergast, live in Kitchener's Stanley Park neighbourhood with their son, John Patrick.

Canada's National Science and Technology Strategy

Alain Beaudet, MD, PhD

Dr. Alain Beaudet, MD, PhD, is the President of the Canadian Institutes of Health Research (CIHR). Before joining CIHR in July 2008, Dr. Beaudet was the President and Chief Executive Officer of the Fonds de la recherche en santé du Québec. Among his accomplishments, Dr. Beaudet built a distinguished career at the world-renowned Montreal Neurological Institute (MNI). He headed the MNI's functional neuroanatomy laboratory and from 1985 to 1992, he was associate director (research) for the MNI. He has also taught in McGill University's Neurology-Neurosurgery and Anatomy-Cell Biology departments.

Dr. Beaudet has written more than 175 original articles and some 40 monographs and book chapters. He has received numerous grants and distinctions, including the Killam postdoctoral fellowship, grants from the Medical Research Council, CIHR and FRSQ, and the Murray L. Barr Junior Scientist Award. In 2007, France bestowed the Order of Academic Palms distinguished Officer's award to him and he was made Doctor honoris causa of Université Pierre et Marie Curie in Paris. Dr. Beaudet earned a medical degree and a PhD in neuroscience from the Université de Montréal. He did postdoctoral training at the Centre d'études nucléaires in Saclay, France and the University of Zurich's Brain Research Institute in Switzerland.

Abstract

Ultimately, health research is about helping people to be healthier. But while there is one definitive destination, there are many paths to get there. It may be through the development of new and better ways to prevent, diagnose and treat disease and promote population health. It may be through providing the evidence that supports the delivery of the health services Canadians need, when and where they need them. And it may be through the commercialization of a health research discovery to make a new product or service available in the marketplace. CIHR supports all of these paths to better health and its new Strategic Plan – Health Research Roadmap: Creating innovative research for better health and health care will provide the direction needed to further Canadian health research.

Dr. Beaudet will be speaking to conference participants regarding CIHR's new five year strategic plan and how it aligns with the principles set out in the federal government's S&T Strategy, including: promoting world class excellence; focusing on priorities; encouraging partnerships, and enhancing accountability. Health research has been acknowledged as an area of S&T strength for Canada. As head of Canada's federal health research agency Dr. Beaudet is committed to ensuring that Canada's health researchers are well positioned on the international stage and have the tools required to innovate and succeed. Dr. Beaudet will speak about how CIHR's Strategic Plan will ensure that health research remains a Canadian strength, spurs innovation and promotes health research excellence.

Dr. Kamiel Gabriel [Moderator]

Dr. Kamiel Gabriel is the founding Associate Provost of Research at the University of Ontario Institute of Technology (UOIT). Under his leadership, UOIT has seen a tremendous growth in its research portfolio

boasting over a 30 fold increase in its research funding in less than five years. To-date, UOIT has attracted close to $28 million of external research funding, placing UOIT in the top 50 research intensive universities in Canada. In addition, he oversaw the exponential growth of UOIT's commercialization of research activities leading to the granting of a number of patents and licenses, a spin-off company and tens of invention disclosures.

Dr. Gabriel holds a Bachelor of Science (honors) degree and a Master of Science degree in Mechanical Engineering from the University of Alexandria in his native country of Egypt, and a Ph.D. degree from the University of Manitoba. He also holds a diploma in Space Science from the International Space University (H/Q in Strasburg, France), and an M.B.A. from the International Business Centre at the Faculty Engineering's Ralph Teetor Educational Award (aerospace), and is listed in the "who-is-who" internationally. Dr. Gabriel is a fellow of the Canadian Engineering Academy.

For thirty years, Dr. Gabriel's research and scholarly career focused on developing new applications in the area of energy and heat management systems for terrestrial and space applications. His research efforts in the area of energy conservation led to the design of an innovative heat exchanger for heat recovery systems in commercial buildings and residential dwellings. He is the co-holder of a U.S. patent in this technology. Between 1988 and 2004, Dr. Gabriel participated in the Canadian Space Science Program leading to the design and testing of a thermal transport system for space applications. His research group logged over 40 hours aboard the NASA Zero-Gravity aircraft, US Space Shuttles and the European Space Agency's Zero-Gravity Airbus. He is the author of numerous articles in this field and has recently published a book on Microgravity Two-Phase Flow and Heat Transfer. He is currently active in research efforts leading to more efficient energy production and energy conservation systems.

Dr. Gabriel is the guest speaker in several local, national and international conferences and workshops. He is a co-founder and currently the President and Chair of the Board of the Durham Strategic Energy Alliance (DSEA); a not-for-profit organization dedicated to the promotion of the Durham region as an energy-friendly place to do business.

In July 2009, Dr. Gabriel was appointed the ADM of Research and Science Adviser at the Ontario Ministry of Research & Innovation.

Heather Monroe-Blum, PhD

Heather Munroe-Blum is Principal and Vice-Chancellor of McGill University and Professor in Medicine. A distinguished psychiatric epidemiologist, she has dedicated her career to the advancement of higher education, science and innovation, in Canada and internationally, advising governments and other organizations on the role that universities and research play in advancing international competitiveness and enriching societies.

Prof. Munroe-Blum serves on numerous not-for-profit and private boards. She is President of the Conférence des recteurs et des principaux des universités du Québec (CREPUQ) and she serves on the executive committees of the Association of Universities and Colleges of Canada (AUCC) and the Association of American Universities (AAU). She chairs the AUCC Standing Advisory Committee on University Research (SACUR), and is a member of the Board of Governors of the Council of Canadian Academies. She is also a member of the federal Science, Technology and Innovation Council (STIC), of the Canada Foundation for Innovation, and of the Trilateral Commission. She serves on the boards of the Sir Mortimer B. Davis Jewish General Hospital, the Conférence de Montréal, the Yellow

Pages Group, and the Canada Forum of Rio Tinto Alcan. She was a founding director of the Medical and Related Sciences Discovery District (MARS) and Genome Canada (where she also served as Vice-Chair of the Board) and has also served on the boards of the former Medical Research Council of Canada, Neurosciences Canada, the Four Seasons Hotel, Alcan, and Hydro One, among others.

Prof. Munroe-Blum holds a Ph.D. with distinction in epidemiology from the University of North Carolina at Chapel Hill, in addition to M.S.W. (Wilfrid Laurier University) and B.A. and B.S.W. degrees (McMaster University). Named an Officer of the Order of Canada for her outstanding record of achievements in science, innovation and higher education policy, she holds numerous honorary degrees from Canadian and international universities. Prof. Munroe-Blum is a Specially Elected Fellow of the Royal Society of Canada and a Senior Fellow of Massey College. She was named a Grande Montréalaise, Montréal's highest honour, in 2008 and received the National Order of Quebec in June 2009.

Prof. Munroe-Blum is married to screenwriter and teacher, Len Blum, and they have one daughter.

Abstract:
The previous decade has seen significant investments to promote science, technology and innovation, but also a new focus on measuring innovation and productivity indicators and beginning to benchmark against national and international peers. Canada's Science, Technology and Innovation System: State of the Nation 2008, released by the Science, Technology and Innovation Council (STIC), created a baseline for understanding where Canada stands in the world and will allow a monitoring of progress over time on key performance indicators. Reports from several governmental and advisory bodies, and numerous organizations, such as the Conference Board of Canada, the Competition Review Panel and the Canadian Council of Academies, are closely tracking Canada's performance, analyzing our assets and proposing solutions.

The message is clear: there is a serious need to improve Canada's competitiveness. Notwithstanding our strengths as a country, we must transform Canada into an innovation society with forward-thinking leadership and a coherent and robust vision for innovation. Canadians can weave wealth creation with strong social values, bringing our concerns for environmental impact, global health, and the need to address disparities for the disenfranchised together with widespread educational achievement, technological uptake, and national and international experience and knowledge, enhancing our competitiveness and advancing our place as a leading civil society.

Christopher Paige, PhD

Dr. Christopher Paige is vice-president, research of the University Health Network, which oversees the Toronto General Hospital, Toronto Western Hospital and Princess Margaret Hospital. He is also a professor in the departments of Medical Biophysics and Immunology and Ronald Buick Chair in Cancer Research at the University of Toronto. He is an active educator in the undergraduate, graduate and postgraduate programs of the University's medical school and is a sought-after speaker at science and medical conferences worldwide. Dr. Paige began his career as a member of the Basel Institute for Immunology in Switzerland where he worked from 1980-1987 before joining the Ontario Cancer Institute as a senior scientist in 1987. In 1990, Dr. Paige became the founding director of the Arthritis and Autoimmunity Research Centre as well as director of research at the Wellesley Hospital in Toronto. In 1998, Dr. Paige

returned to the Ontario Cancer Institute and subsequently assumed his current position at the University of Toronto. He is an internationally recognized leader in the area of lymphocyte development and antibody formation. He is the principal investigator in a Terry Fox Program project on blood cell development and his research has been supported for many years by the Canadian Institutes of Health Research and the National Cancer Institute of Canada. His original research is published in leading scientific journals. He has served on the advisory boards of the National Cancer Institute and the Arthritis Society of Canada.

Dr. Paige earned a Ph.D. in Immunology at the Sloan-Kettering Division of Cornell University Graduate School of Medical Sciences in 1979. Dr. Paige chairs the board of the Toronto Biotechnology Commercialization Center, a biotechnology incubator developed in partnership with the MaRS Centre and the Toronto Academic Health Sciences Network. He is also chair of BioDiscovery Toronto, one of Ontario's Regional Innovation Networks, designed to provide a coordinated storefront for the research business development offices of the hospitals and universities in the Greater Toronto Area.

Peter Singer, PhD

Professor Peter A. Singer is Professor of Medicine, Sun Life Financial Chair in Bioethics and Director at the McLaughlin-Rotman Centre for Global Health, University Health Network and University of Toronto. Singer's research is on life sciences and the developing world – how technologies make the transition from "lab to village". In 2007, Singer was awarded the Michael Smith Prize by the Canadian Institutes of Health Research as Canada's Health Research of the Year in Population Health and Health Services. He is a Fellow of the Royal Society of Canada, the Canadian Academy of Health Sciences, and the US Institute of Medicine of the National Academies. He has published over 260 research articles, received over $50 million in research grants, and trained over 70 students. Singer is a member of the Scientific Advisory Board of the Bill & Melinda Gates Foundation Grand Challenges for Global Health Initiative, and has advised the UN Secretary General's Office, the Government of Canada, several African Governments, and Pepsico Inc on issues related to global health. He studied internal medicine at University of Toronto, medical ethics at University of Chicago, public health at Yale University, and management at Harvard Business School. He is a former chairman of Branksome Hall School.

Abstract: "From Blue Helmets to White Lab Coats"

Canada's significant science and technology (S&T) strengths – in health and related life sciences, information and communications technologies, and energy and environmental technologies – could be mobilized to address the pressing challenges of the developing world such as global health, food security, energy, and climate change.

Canada already has many of the necessary institutions: the International Development Research Centre, the Development Innovation Fund, and the Global Health Research Initiative. There are also important roles that could be played by Canadian universities, industry and by our diaspora scientists and engineers.

Although these innovations would be focused on the challenges of the developing world, they could also have a significant impact domestically by helping to address a range of shared threats including climate change, chronic disease, and H1N1. Some solutions could also find application in our Aboriginal communities.

While such a strategy might begin with development, it would quickly reinforce our

international competitiveness and trade relations, where we have developed science and technology agreements and partnership programs with India and China. It would also strengthen our approach to diplomacy.

It has been half a century since Canada made a truly distinctive global contribution through its foreign policy. In the same way that we once led the world through peacekeeping, we now have the opportunity to become the leaders in science and foreign policy. Our distinctive new global brand would be innovation – Canada helps developing countries solve their problems using science. We could lead the way and inspire other nations to follow – beginning with the upcoming opportunities of the G8 and G20 meetings and our bid to join the UN Security Council.

Scientific knowledge and decision-making: Lessons learned and new models

Eleanor Fast
Eleanor Fast is Program Director at the Council of Canadian Academies.

Prior to joining the Council in 2008, Eleanor was a Science and Technology Analyst at the Library of Parliament, providing research and analysis to Parliamentarians and to Parliamentary Committees, particularly the House of Commons Standing Committee on Industry, Science and Technology.

Previously, she was Science Adviser at the British High Commission in Ottawa, representing UK science interests in Canada and facilitating UK-Canada science collaboration.

Eleanor is active in a number of community organizations, including as Chair of the Board of Directors of VistaKSAP, a group of non-profit school-based daycares. She has an MSc in Natural Resource Sciences and a BSc in Biology, both from McGill University.

Abstract:
Independence, transparency and quality are key to ensuring the credibility of science advice. With these principles at its core, the Council of Canadian Academies facilitates access to the best available scientific knowledge to inform public debate and decision-making. The Council's in-depth expert assessments provide a solid, evidence-based foundation for medium to long-term decision-making. However, new technologies are changing the way the public and, by extension, decision-makers receive and process information. There is movement from depth to speed, from elite to public "wiki" authorities, from old media to new media. This Science Policy Conference itself emerged from the desire of graduate students and postdoctoral fellows - the next generation - to join the discussion on new models for implementing scientific knowledge in the decision-making process. There are many Canadian organizations providing science advice; can they collectively develop a new model which combines independence, transparency, and quality with speed, public engagement, and training of the next generation?

Adam Holbrook, P. Eng. [Moderator]
Adam Holbrook is an adjunct professor and Associate Director of the Centre for Policy Research on Science and Technology (CPROST), at Simon Fraser University in Vancouver, BC. Prof. Holbrook was trained as a physicist and electrical engineer and is a registered professional engineer in the provinces of Ontario and BC.

After starting his career at Telesat Canada, he joined the federal government of Canada as the program officer for S&T programs at the Treasury Board Secretariat. He later transferred to the Ministry of State for

Science and Technology (MOSST), and remained involved in science policy activities for the federal government after MOSST was absorbed into Industry Canada. In 1995 he moved to Simon Fraser University to join CPROST.

At CPROST his research activities centre on the analysis of science, technology and innovation activities in both the public and private sector. He is a member of the management committee of the national Innovation Systems Research Network. He has published extensively in academic journals and has edited three books on regional innovation systems in Canada and has carried out teaching and consulting activities in S&T and innovation policy for several international development agencies.

Bryn Lender & Janet Atkinson-Grosjean

Bryn Lander is a PhD student in the Interdisciplinary Studies Graduate Program at the University of British Columbia. Her dissertation analyses the interface between scientific research and clinical practice.

Bryn has studied science and technology policy through an analysis of regenerative medicine research and development in India within the McLaughlin-Rothman Centre for Global Health, University of Toronto, and through a Masters in Science and Technology Policy at SPRU, University of Sussex, England.

Bryn has worked as a science policy analyst at Environment Canada and as an analyst at the Dean of Medicine's Office at the University of Washington, Seattle.

Abstract:
Science policies and funding agreements require scientists to demonstrate the socio-economic benefits of their work. To date, however, primary policy attention has been focused on capturing the economic benefits of research while the social side of the equation has been neglected. Yet while there are relatively few scientists engaged in commercial translation, many scientists are involved in some type of non-economic translational activity, whether in the clinical domain or the civic arena, most of which are overlooked in conventional reporting. A goal of this paper is to begin to broaden the conception of translational science, moving it beyond the transfer of technology from academy to industry, to include contributions from clinical and civic engagement.

For funders interested in tracking and measuring translation of the research they support, a broader understanding would more accurately reflect and capture how the translational activities of Canadian scientists contribute to social objectives. For scientists, a broader definition of translational science would allow recognition of activities they currently undertake, increasing not only the potential that they will engage in translational science but also the likelihood of successful translation. Overall, a more inclusive model would help demonstrate to taxpayers how their investment in scientific research translates into tangible benefits for society.

Jeff Kinder

Jeff Kinder has twenty years of experience in government science and technology (S&T) policy in the U.S. and Canada. His experience in the U.S. includes work at the National Science Foundation, the National Academies' Committee on Science, Engineering and Public Policy, and research in applied ocean acoustics at the Naval Research Laboratory. In Canada, Jeff has worked as Senior Policy Advisor in Science and Innovation at Industry Canada and in support of the Council of Science and Technology Advisors (CSTA), the external board that advised Cabinet on the management of federal S&T from 1998-2007. He is currently Manager, S&T Strategy, at Natural Resources Canada. Jeff is also a Ph.D. candidate in the School of Public

Policy and Administration at Carleton University where his research and teaching focuses on S&T policy, government laboratories, innovation systems and science advisory mechanisms. He is the co-author with Bruce Doern of Strategic Science in the Public Interest: Canada's Government Laboratories and Science-Based Agencies (University of Toronto Press, 2007) and is preparing a history of the Science Council of Canada.

Abstract:
The pervasiveness of science and technology in all facets of our lives and the greater complexity of policy issues in the knowledge-based society have underscored the importance of sound science advice as a key input to public policy. But who aids policymakers in understanding science and technology matters? Governments seek the advice of experts on how to most effectively foster innovation, advance scientific frontiers, promote sustainable development, protect the environment and ensure the health and safety of Canadians. With an increased focus on the use of scientific advice in policy making, there is a need to better understand the science advisory mechanisms that the Canadian government has employed. This paper examines the key elements of science policy advisory structures in Canada.

John Leggat, PhD

John Leggat is an Associate Consultant with CFN Consultants. Prior to joining CFN in September 2005, he was the Assistant Deputy Minister (Science & Technology) for the Department of National Defence and the Chief Executive Officer of Defence Research and Development Canada (DRDC). During his career, he has served in a number of other appointments in Defence R&D, including Director General of DRDC's Ottawa research centre and Director General for Technology Development. Dr. Leggat is the President of the International Council of Academies of Engineering and Technological Sciences and Past President of the Canadian Academy of Engineering. He is a member of Science Advisory Committee of the Department of Fisheries and Oceans and a Board Member of the Canadian Association of Defence and Security Industries. He is an Honorary Member of the Engineering Institute of Canada and a Fellow of the Canadian Academy of Engineering.

Abstract:
The relationship between science and decision making is a science in itself. When decisions are straight forward, they are underpinned by factors that are well defined, a decision frame that is trusted, and outcomes that can be reasonably well predicted. Whether in business or government, few decision making processes present this luxury, and important decisions invariably involve an interleaving of complex issues. In many organizational decisions, science is not a factor. Often it is an afterthought or side issue; rarely is it a mainline item that contributes to an organization's core agenda. The presentation will address science and organizational decision making from a public sector perspective. It will include thoughts on the science-policy interface and how it can be managed so that timely and relevant science input is integral to complex decision making.

Ann McMillan, PhD

Ann is with the Department of Fisheries and Oceans Canada (DFO) working on aspects of Climate Change and the Arctic. Previously, she was with Environment Canada for almost 20 years, starting as a research manager, moving to the supervision of science assessments and then on into policy based on science. She was the Chair of the Science Subcommittee under the Canada/US Air Quality Agreement for a decade and initiated the science assessment work on air quality modelling of particulate matter as the basis of bilateral discussions on air quality policy.

Abstract:
Moving science from technical results into the hands of decision makers in a useful way is a challenging task. Science and policy cultures are different in terms of time scales, expectations, and communication of results. If policies are to be based on science, it is important that policymakers take sufficient responsibility for defining what they need from the scientific community to structure the dialogue. One successful tool for establishing this structure, is the science assessment. The assessment is best initiated by both communities together formulating a set of "questions" the answer to which will provide a conduit for scientific information to be channeled into policy. Formulating the questions is important, and must be done sufficiently in advance of the need for the output to allow the assessors to work with the science community to assemble the answers.

Science assessments on particular issues such as "acid rain" have been around for decades. More recently organizations such as the Council of Canadian Academies (CCA) have taken on the role of providing assessments. Within DFO we have the Canadian Science Advisory Secretariat (CSAS) which takes on this role. Science assessment is a well defined tool that works successfully to bring the science and policy communities together over issues moving from science to policy.

Who speaks for science? Stakeholder communication in the Canadian scientific community

Reinhart Reithmeier, PhD
Dr. Reithmeier is Chair of the Biochemistry Department at the University of Toronto.

Robert Mann, PhD
Robert Mann has a B.Sc. in physics from McMaster University and an M.Sc. and Ph.D from the University of Toronto. Currently a Professor of Physics at the University of Waterloo, he has been a visiting researcher at Harvard University, Cambridge University, and the Kavli Institute for Theoretical Physics. He has received several awards, including most recently a Fulbright Fellowship, an award for Teaching Excellence from the Ontario Undergraduate Student Alliance, and an Outstanding Referee Award from the American Physical Society. A member of several advisory boards for different foundations, research institutes, and grant selection committees, he was chair of the Department of Physics and Astronomy at the University of Waterloo from 2001-2008. He is currently President of the Canadian Association of Physicists. His research interests are in black holes, cosmology, particle physics, quantum foundations, and quantum information.

Abstract: "Charting a Course for Canadian Physics"

Canada's approach to science policy has seen a number of substantial changes over the past decade, affecting every scientific discipline. These changes have been the result of an ongoing interplay between top-down government program changes, philanthropic aspirations,
changes in the economic landscape, and grassroots initiatives from Canada's scientists. The situation for physics has been particularly exciting and challenge, with several major new developments that have significantly altered how physics is done in Canada. After taking stock of the current situation, I will describe the efforts being undertaken by the Canadian Association of Physics in charting a future course for Physics in Canada, and what is needed in Canadian science policy to ensure its success.

Deb deBruijn

Deb deBruijn is Executive Director of the Canadian Research Knowledge Network

Rees Kassen, PhD

Dr. Rees Kassen is associate professor and University Research Chair in Experimental Evolution at the University of Ottawa. He is also Chair of the Partnership Group for Science and Engineering (PAGSE), an association of over 25 professional and scientific organizations representing 50,000 members from academia, industry and government. He completed his PhD at McGill University and then went on to an NSERC Postdoctoral Fellowship and Elizabeth Wordsworth Research Fellowship at St Hugh's College, Oxford. Dr Kassen is known internationally for his integrative approach to the study of biodiversity and pioneering work using microbes to study evolutionary and ecological processes in the laboratory.

Abstract:
The Partnership Group for Science and Engineering (PAGSE) was formed in 1995 as a cooperative association of national science and engineering organizations representing academia, government, and industry. Member organizations work together, and in a collegial spirit with government, to advance research and innovation for the benefit of Canadians. We are not a lobby group: we do not seek to advance specific initiatives nor do we ask directly for money. Rather, we address broader issues of science and engineering policy at the national level. PAGSE has built over the years a solid reputation with parliamentarians and decision makers as a credible and valued source of advice and information on scientific and engineering issues. The presentation will discuss the strategies PAGSE uses to make the opinions of the scientific research community known to Government and to educate parliamentarians and decision makers on topical issues of a scientific nature.

Kevin Shortt [Moderator]

Kevin has worked in Canada's space industry for over 8 years and has contributed to some of Canada's largest space missions. During his undergraduate studies at York University, he worked as a Research Assistant in the Instrument Services Lab at the Centre for Research in Earth and Space Technology (CRESTech) where he contributed to and maintained lab standards in addition to a variety of other spacecraft instrumentation research tasks. In 1999, he took a position as a Mission Planner for the RADARSAT-1 program at the Canadian Space Agency where he was part of the team responsible for the day to day image acquisition operations and calibration activities for the spacecraft. Following his term at the CSA, he worked as a Research Assistant at the Meteorological Services of Canada where he performed a variety of design tasks for a dual-spectrometer instrument that is currently operating on board the SCISAT-1 spacecraft to detect ozone concentrations in the Earth's atmosphere. From 2004 to 2006, he worked with the design team responsible for the lidar instrument on board NASA's Mars Phoenix Scout mission which operated on the Martian surface for 5 months in 2008.

Currently, he is involved in research on a new generation of laser communications system for use in ground-to-satellite communications while pursuing a masters degree in electrical engineering at the Royal Military College of Canada. He is also serving as President of the Canadian Space Society, Canada's leading non-profit organization dedicated to space technology development. In this role he works with members of government, academia and industry to further space technology

development in Canada and can often be found discussing space issues on CBC and CTV National news.

The Canadian economy: From resource-based to knowledge-driven

Peter Nicholson, PhD

Peter J.M. Nicholson became the inaugural president of the Council of Canadian Academies in February, 2006. The Council supports expert panels that assess the science that is relevant to issues of public importance. Educated in physics (BSc, MSc, Dalhousie) and operations research (PhD, Stanford), Dr. Nicholson has served in numerous posts in government, business, science, and higher education. Before assuming his current position, he was Deputy Chief of Staff, Policy in the Office of the Prime Minister of Canada. He has served in a number of public service positions over the past 36 years including as a member of the Nova Scotia Legislature, Clifford Clark Visiting Economist in Finance Canada, and as Special Advisor to the Secretary-general of the OECD in Paris. Dr. Nicholson's business career has included senior executive positions with Scotiabank in Toronto and BCE Inc. in Montreal. Dr. Nicholson began his career in the academic sector where he taught computer science at the University of Minnesota (1969-73). He was also an original member of the Prime Minister's National Advisory Board on Science and Technology, the founding Chair of the Board of the Fields Institute for Research in Mathematical Sciences and was the founding Chair of the Members of the Canada Foundation for Innovation. Dr. Nicholson is a Member of the Order of Canada.

Abstract:
Resources have been, and will continue to be, one important source of Canada's prosperity and the profitability of our businesses. But while the traditional orientation of our economy to commodity products (resource-based and otherwise) has not, so far, hurt overall Canadian business profitability, a "commodity focus" has reduced the incentive to adopt innovation-oriented strategies. It will be argued that the environment facing Canadian business is changing fundamentally owing to a combination of factors including increased vulnerability arising from our dependence on the US market; resource price volatility and environmental concerns; and new opportunities as well as new competitive challenges from emerging economies. These changed circumstances are creating incentives for Canadian business to place much greater strategic emphasis on innovation.

Suzanne Fortier, PhD

Dr. Suzanne Fortier has served as President of the Natural Sciences and Engineering Research Council of Canada (NSERC) since January 2006.

Before her appointment to this position, Dr. Fortier was a member of Queen's University as Professor in both the Department of Chemistry and the School of Computing. She also served as Vice-Principal (Research) from 1995 to 2000 and Vice-Principal (Academic) from 2000 to 2005.

Dr. Fortier is currently a member of the Ontario Task Force on Competitiveness, Productivity and Economic Progress, and the Board of Directors of the Canada Foundation for Innovation.

Abstract:
Advanced knowledge is the key to securing a strong position in the highly competitive global economy Unparalleled increases in both the pace and scope of scientific discoveries are continuously redefining the frontiers of knowledge and most countries, including Canada, are taking steps to

develop and nurture their capacity to explore and exploit these frontiers.

The current economic crisis has increased the need for all Canadian economic sectors, including those that are based upon more traditional manufacturing or natural resources, to become and to remain agile and competitive through up-to-date science and technology. Connecting and applying the strength of the academic research system to address the opportunities and challenges of building prosperity for Canada is crucial and urgent. To address this need, NSERC will be launching in the Fall its renewed Strategy for Partnerships and Innovation.

Chad Gaffield, PhD [Moderator]

Chad Gaffield, one of Canada's foremost social historians, came to SSHRC from the University of Ottawa, where he was the founding director of the Institute of Canadian Studies and, most recently, held a University Research Chair. During his 20-year University of Ottawa career, he also served as vice-dean of graduate studies and on the executive committee of the board of governors. He is a former president of the Canadian Historical Association and the Canadian Federation for the Humanities and Social Sciences.

An expert on the sociocultural history of 19th- and 20th-century Canada, Gaffield led the Canadian Century Research Infrastructure Project (CCRI), one of Canada's largest and most innovative research projects in the social sciences and humanities. By applying digital technology to the country's rich mine of historical census information, the CCRI enables unprecedented and profound analysis of the forces that have shaped the modern nation.

In 2003 Gaffield was honoured with the Queen's Golden Jubilee Medal. A Fellow of the Royal Society of Canada, he received the society's 2004 Tyrrell Medal for his outstanding contribution to the study of Canada.

Chad Gaffield received his BA and MA from University McGill, and his PhD from the University of Toronto.

Peter Hackett, PhD

Peter Hackett is Executive Professor in the School of Business, Special Advisor to the Vice-president Research and a Distinguished Fellow of the National Institute for Nanotechnology at the University of Alberta. He is a past President of the Alberta Ingenuity Fund and past Vice-president Research of the National Research Council of Canada.

He was the NRC executive responsible for establishing the National Institute for Nanotechnology in Edmonton and led similar technology cluster initiatives for NRC in cities all across Canada. He helped deliver federal government funding for genomics research and has championed the role of Canada in developing technologies that further global human development.

He actively supported entrepreneurship at NRC and while he was Vice-president the research program created over 50 spin-off companies.

In his five years at Alberta Ingenuity, he grew the organization from program expenditures of $10 million to $60 million per year. In 2009, the organization launched five new Alberta Ingenuity Centres and the Alberta Ingenuity Accelerator in Nanotechnology under his leadership.

A chemical physicist, he has authored over 200 publications including 7 patents in photochemistry, the use of lasers in chemistry, and in nanotechnology. He has been awarded the Rutherford Medal in Chemistry of the Royal Society of Canada,

the Noranda Lecture Award of the Chemical Institute of Canada, the Canada Award for Excellence in Technology Transfer, and the Alberta Centennial Medal. He is also a Fellow of the Chemical Institute of Canada, the Chemical Society of London, and has been a Visiting Fellow of the Science and Technology Agency of Japan. In 2007, he was named one of four 125th Anniversary Specially Elected Fellows of the Royal Society of Canada, together with Mike Lazaridis, Louise Arbour, and Robert Pritchard.

Abstract : "Images along the way"

In this talk we will reflect upon the motivations and upon the role of individual scientists and innovators in advancing development by illuminating a number of images that provide insight into what works and what does work not as we seek policies to improve Canada's innovation performance.

Mark Lievonen

Mark Lievonen is President of Sanofi Pasteur Limited and a member of the company's North American Board of Directors. Sanofi pasteur researches, develops and manufactures vaccines for Canadians and for export to global markets. Mr. Lievonen has been with the company since 1983. He started in the treasury department and was promoted to Corporate Vice President, Finance, in 1988. Since 1990, Mr. Lievonen has held a number of senior management positions, including responsibility for the company's commercial operations. Prior to his appointment as President in March 1999, Mr. Lievonen was Senior Vice President and General Manager of the Oncology Business Unit. He was responsible for the strategy and funding of sanofi pasteur's Cancer Vaccine Program and the global marketing and sales of its cancer immunotherapeutic products. Mr. Lievonen holds a BBA in accounting and an MBA in finance and marketing from the Schulich School of Business, York University. He is a Chartered Accountant and received his designation in 1981 while working with PricewaterhouseCoopers. Mr. Lievonen is currently a member of the Board of Directors of Oncolytics Biotech Inc. and the Ontario Institute for Cancer Research. He was a member of the Board of the Ontario Genomics Institute where, he served as Chair from 2004-2008. He has also served on a number of industry boards and councils such as BIOTECanada, where he was Chair from 2000 to May 2003, and on the BIOCouncil, an advisory group to the Government of Ontario in biotechnology. He was Chair of the Steering Committee for the BIO 2002 International Conference which was held in Toronto in June 2002. Mr. Lievonen is a member of the Board of Governors of York University and serves on the Markham Stouffville Hospital Foundation Board. He also served as a member of the United Way of Greater Toronto Cabinet chairing the Health Care Division. Mr. Lievonen was the recipient of a Queen's Golden Jubilee Medallion in 2002 and was named a Chevalier de l'Ordre National de Mérite by the government of France in 2007. He was elected as a Fellow of the Institute of Chartered Accountants of Ontario in 2009.

Abstract:

Mr. Lievonen's presentation will focus on Canada's potential to be a leader in the biotechnology and healthcare economy. He will touch briefly on the evolution of sanofi pasteur in Canada as an example of leadership in the knowledge economy and what is possible through collaboration and innovation. From this industry perspective, Mr. Lievonen will provide suggestions on how government policy can be shaped to encourage innovation and help turn Canadian science into commercial successes.

Canada's environment and energy policies

Hadi Dowlatabadi, PhD

Dowlatabadi is Canada Research Chair & Professor in Applied Mathematics and Global Change, at the University of British Columbia. He is a University Fellow at Resources for the Future, a Washington think tank. He is also Adjunct Professor at Carnegie Mellon University's Department of Engineering & Public Policy. He received his BSc from dinburgh (1980) and his PhD in physics from Cambridge University (1984). His research is at the nexus of humans, technology and the environment. He has studied climate change and its context of global change along with viable response strategies since 1986. His research is solution oriented and often falling outside disciplinary grounds. He sees the world as a dynamic non-equilibrium heterogeneous system where the search for complexity leads to paralysis and over-simplification spells trouble.

Hadi has a few publications, from books on how to choose electricity generation technologies to determinants of malaria around the world. He has over 150 peer-reviewed papers and has supervised about three-dozen PhDs. He serves on the editorial boards of four journals. He is co-founder of the
non-profit Offsetters Climate Neutral Society (www.offsetters.org), CTO of Green-Erg Technologies Ltd (www.green-erg.com), and a Director of REV Ltd.
In 1989 Hadi was awarded the Rockefeller Foundation's, Warren Weaver Fellowship. He and Tim Weiskel were given $50 M to initiate an environmental program. They responded by designing Leaders in Environment and Development. In academia, he and his distinguished colleagues have raised more than $30 M in research funding.

Randall Goodfellow

When Mr. Goodfellow joined Ensyn in 2008, he was already well known to the company, as Ensyn had been a longstanding client of his consulting firm. In his current capacity, he oversees the public affairs, government relations and communications activities of the company.

A consultant since 1991, Mr. Goodfellow has advised senior executives from the private, public and academic sectors on policy and communications issues related to bio-energy, bio-chemicals and renewable resource product generation. He was the founding President of BioProducts Canada.

Mr. Goodfellow has a BSc (Agr) from McGill University.

Andrew Miall, PhD

Andrew Miall obtained his B.Sc. in Geology at University of London in 1965, immigrated to Canada and completed a Ph.D. at University of Ottawa, in 1969. He worked for several oil companies, and then the Geological Survey of Canada as Research Scientist (1972-1979) and has been Professor of Geology at University of Toronto since 1979. Miall has been Editor of Geoscience Canada (1982-1989), and Co-Chief Editor of Sedimentary Geology (Elsevier)(1987-2005). He is the author, co-author or editor of ten books, including "Principles of Sedimentary Basin Analysis", now in its third edition, and "Canada Rocks: The Geologic Journey", by N. Eyles and A. D. Miall (2007).

Miall was elected Fellow of the Royal Society of Canada in 1995, and served as Vice President (2005-2007) and President (2007-2009) of the Academy of Science.

Abstract:
Science policies should be carefully considered plans designed to implement important societal goals. In reality they are

commonly a series of ad-hoc decisions responding to public moods and appeasing pressure groups. In-house government scientific expertise is commonly poorly funded research designed to serve short-term pressures, liable to cancellation during budget crises. Scientific results may be unpopular or conflict with current political needs and may then be ignored or suppressed. National objectives are confused by the division of responsibilities between federal and provincial levels of government. The public is commonly poorly informed about complex scientific issues, because of sensationalistic electronic media or misleading/exaggerated claims by interest groups. While print-media often do an excellent job of scientific reporting, television coverage too often picks sensational or eccentric stories, gives too much air time to special-interest groups, and tends to present controversy in the form of equal-time "talking-head" debates, which may convey incomplete evidence relating to a difficult issue. Stories that lack drama will be ignored.

Abstract:
What are more appropriate science-policy interactions for Canada? Why do so few public policies seem to build on available scientific evidence? Why has billions of funding built so many buildings and so few bridges between industry and academy? Are there better models for us to adopt in Canada.

Geoff Munro

Geoff Munro was appointed Assistant Deputy Minister of the newly formed Innovation and Energy Technology Sector (IETS) at Natural Resources Canada on April 14, 2009. In these capacities, Mr. Munro works to position NRCan's science and technology and its energy research and development within the Canadian innovation system and in broader international arenas. Since June 25, 2007, Mr. Munro has also served as the Chief Scientist for Natural Resources Canada and leads the implementation of the department's science and technology strategy, as well as representing the department and Canada on a number of interdepartmental and international committees, including: the federal ADM S&T Committee, the United Nations Environmental Programme (UNEP) Resource Panel Steering Committee, and the National Roundtable on the Environment and Energy (NRTEE) Expert Advisory Committee on Water Sustainability and Canada's Natural Resource Sectors.

Abstract:
The world is facing complex issues at the intersection of energy and environment, and muscience, technology and innovation are key to addressing them. Building on our core strengths, Canada has an opportunity to make the energy/environment nexus our global S&T niche and to become a world-leading clean energy innovator. In his presentation, Geoff Munro will
speak to Government of Canada's efforts to engage all sectors of Canada's science and innovation system and position Canada as a global leader in critical areas such as carbon capture and storage, renewable energy, and energy efficient communities.

Governance of emerging technologies

Christian Burks, PhD

Dr. Burks' career has focused on developing scientific programs and companies; fund raising from and partnering with public and private institutions; and harnessing genomics to create a new foundation for the development of life science applications and products. Since 2004, he has been OGI's President and CEO as well as served on its Board of Directors. During this period, OGI has initiated genomics research projects with ~$330M in total funding and created new programs to increase the use, impact and understanding of genomics. Previously,

he was CSO with Affinium (Toronto); CIO with Exelixis (South San Francisco); and, at Los Alamos National Laboratory, led GenBank, created by a team he joined as a post-doc. Dr. Burks has co-authored over 65 publications and served internationally on numerous editorial, advisory and governing boards. Following a B.A. in the Great Books Program at St. John's College, he completed a PhD at Yale University.

Abstract: "Stewardship of Research Resources"

Basic scientific inquiry usually relies on and often generates research resources. Such resources range from infrastructure to consumables to data and knowledge. At the leading, bleeding edge, such resources are usually being modified and improved in near real time, and thus are best maintained by (and therefore supplied by) academia. At the point their technological development has stabilized and when there is a market for producing and selling them at scale, such resources are usually maintained by (and therefore supplied by) industry. There is, however, a middle ground where resources could and should be stabilized, but for strategic and/or market-based reasons, need to be maintained and provided longer-term without the direct support of industry. Long-term stewardship of established genomics research resources provides an example where a focused policy framework (and associated public funding) is largely lacking in Canada, but which would accelerate the impact of the basic research which creates those resources.

Marc Fortin, PhD

Dr. Marc Fortin joined Agriculture and Agri-Food Canada (AAFC) as Assistant Deputy Minister, Research Branch, in 2006. Since, he has been leading AAFC's research activities and the evolution of the Branch toward a role of national leadership in public research while mobilizing and increasing the private research capacity. A federal, provincial and territorial agreement has allowed the acceleration of the pace of innovation in that sector. Prior to 2006, he was at McGill University where he conducted research and also served as Chair and Associate Dean in the Faculty of Agricultural and Environmental Science. He led national and international research groups. He was a member of the Royal Society of Canada's Expert Panel on the Future of Food Biotechnology in Canada, a William Dawson Scholar at McGill University, and was Director of Science Policy for the Canadian Society of Plant Physiologists. Dr. Fortin is a graduate of McGill University (PhD) and of Université Laval (MSc and BSc) and conducted research at The University of Chicago and at The University of California at Davis.

Abstract:

An innovative application of foresight engages and mobilizes government, industry and academic stakeholders in an innovation system to develop coordinated horizontal action plans to achieve benefits beyond what individual actors could accomplish on their own. Foresight is a systems oriented strategic planning tool, and a multi-stakeholder engagement process that helps decision-makers better understand the future implications of decisions they take today. Foresight explores future possibilities and their implications for science and technology, policies and programs, regulations, marketing, and industry strategies in the context of potential challenges and opportunities facing governments, industry and Canadians. It helps stakeholders to develop a common understanding of possibilities and implications and to build a willingness to act in a coordinated and collaborative manner with others to accomplish common goals.

Dr. Patricia Kosseim

[Moderator]

Patricia has joined Genome Canada on a two-year Executive Interchange arrangement to lead a national strategy for addressing ethical, economic, environmental, legal and social (GE^3LS) issues related to large-scale genomics research. She joins Genome Canada from her home institution, the Office of the Privacy Commissioner of Canada (OPC), where she has held the position of General Counsel since January 2005, responsible for the activities of the Legal Services, Policy and Parliamentary Affairs Branch.

Before joining OPC, Patricia spent five years building and heading up the Ethics Office of the Canadian Institutes of Health Research. During this period, she was briefly seconded to Canada Health Infoway Inc. to advise on privacy issues related to the development of pan-Canadian electronic health record systems.

Patricia worked in Montreal for over six years with the national law firm of Heenan Blaikie, practicing primarily in the areas of health law, human rights, labor & employment law, privacy law, administrative law, professional liability and civil litigation.

Called to the Québec Bar in 1993, Patricia holds degrees in Business (B.Com '87) and Laws (B.C.L. / LL.B. '92) from McGill University, and a Master's Degree in Medical Law and Ethics (M.A.'94) from King's College, University of London (U.K.).

Nils Petersen, PhD

Nils O. Petersen, PhD in Physical Chemistry with expertise in microscopy and spectroscopy of biological systems. He is the Director General at NRC for the National Institute for Nanotechnology and a Professor of Chemistry at University of Alberta. Dr. Peterson has served as the Vice-President of Research at University of Western Ontario, as well as being a member of several Boards, including the Canadian Light Source, California NanoSystems Institute, ArboraNano, Pacific Institute of Mathematical Sciences and the BioPsys NSERC Strategic Network.

Abstract: "The case of Nanotechnology"

Nanotechnology has come to the fore in the last two decades because of new tools for manipulation and control of matter at a small scale, but in reality it has been emerging for about a century through our understanding of the molecular nature of matter. Most importantly, the novel technologies emerging as a consequence of our new-found knowledge and understanding, in whatever name we choose to use, will be with us forever and we must act accordingly. The potential for nanotechnology is pervasive and transformative and is rooted in our ability to develop new materials, to integrate concepts drawn from multiple disciplines, and to create new systems with better or unique performance.

Governance of nanotechnology must be done with care. On the one hand, we must recognize that we are developing new materials with new properties and therefore we must try to anticipate unintended consequences. On the other hand, there is probably no single regulatory or governance principle that can encompass the breadth of activities within this emerging technology. Moreover, there are likely to be a significant body of regulatory frameworks within existing disciplines that can be brought to bear.

In this presentation, the focus will be on the scope of nanotechnology and the areas in which we need to focus the attention of scientists and engineers as develop this exciting new frontier.

Bryn Williams-Jones, PhD

Bryn Williams-Jones, PhD, is an Assistant Professor in the Bioethics Programmes, Department of Social and Preventive Medicine, School of Public Health, at the University of Montreal. Bryn is an interdisciplinary scholar who employs analytic tools from applied ethics, health policy and the social sciences to explore the socio-ethical implications of new biotechnologies. His current research focuses on the commercialization of biomedical technologies, the integration of ethical analyses in the evaluation of health innovations, and the management of conflicts of interest that arise in the context of university research and in particular university-industry relations.

Abstract:
With the emergence over the last 3 years of "personal genomics" companies such as 23andMe, deCodeMe and Navigenics offering personalized lifestyle and health information to consumers, there has been renewed academic and public policy debate about the social, ethical and policy implications associated with consumer/patient access to genomic screening technologies. Much of the current debate focuses on issues related to clinical utility of resulting information, truth in advertising, cost-effectiveness and inclusion in health insurance plans, and the need to regulate (or not) how these technologies are made available to the public. Interestingly, these are almost exactly the same issues that have been under discussion for more than a decade, in the context of direct-to-consumer genetic testing. What is missing from much of the current debate, however, is a recognition that the information provided by personal genomics companies surpasses simple "medical / non-medical information" classifications. There is a blurring of boundaries or convergence of categories occurring, and this poses serious challenges for existing public health policies, and any moves to regulate or govern emerging personal genomics technologies.

Private sector research and development: its role in the global economy

Éric Archambault, PhD

Eric Archambault is the president of Science-Metrix, a Canadian company specializing in science and technology (S&T) evaluation and measurement founded in 2002. He has 15 years' experience in the measurement and evaluation of S&T and has been immersed in S&T policy for 23 years. Dr. Archambault has directed more than a hundred S&T evaluation, measurement and policy related projects during his seven years as head of Science-Metrix. He has an excellent knowledge of the issues surrounding the evolution and monitoring of research, education and policy, acquired not only as a consultant and academic researcher working on these issues, but also through his rather rare academic trajectory involving three degrees that focused on the evolution of science, technology and the research environment (a B.Sc. in Science, Technology and Society from the Université du Québec à Montréal (UQAM), Montreal, and, from the University of Sussex, UK, an M.Sc. in Science, Technology and Industrialization, and a D.Phil. in Science and Technology Policy Studies).

Abstract:
Using statistics on trade, research expenditures, patents and papers published, an assessment is made of Canadian industry competitiveness. A
comparison is made with a number of indicators for Austria, Denmark, Finland, the Netherlands, Norway, Sweden, and Switzerland. Trade statistics
shows that, relative to what is observed in these comparably developed but somewhat smaller countries, Canadian industry lack competitiveness in high technology as

Canada has soaring deficits in most of high tech products trade. In addition, by and large, Canadian industry, just as much as Canada generally, under-invest in R&D. Patenting performance is also substantially below that of the comparable countries examined. Thus, the evidence strongly suggests that Canadian industry can be characterized as having lackluster performance.

Peter Frise, PhD

Peter Frise was educated as a Mechanical Engineer at Queen's and Carleton universities and has worked in the petroleum and plastics manufacturing sectors in Canada and abroad. He is now the Scientific Director and CEO of the AUTO21 Network of Centres of Excellence, Canada's national automotive R&D program. AUTO21 brings together over 200 researchers and more than 500 graduate students from 45 institutions in partnership with over 220 industry and public sector companies and organizations to engage in applied automotive R&D. Through 2010, AUTO21 will have completed more than $90M worth of automotive research, of which nearly half has come from partner organizations. He serves on several boards, including the National Research Council of Canada, the Defence Science Advisory Board of Canada and the Yves Landry Foundation.

Abstract:

The presentation will focus on automotive manufacturing which produces high technology articles that represent one of the largest purchases for most Canadians. The automotive sector is under significant competitive pressures and must innovate to remain in Canada. Major technological and business trends will be described along with how they affect Canada's automotive industry. The role of R&D and innovation will be discussed as well as ideas to ensure that our country continues to contribute to the future auto industry and derive the employment and other economic benefits from that involvement.

Philip Schwab, PhD

As Vice-President for Industry Relations at BIOTECanada, Phil is responsible for policy development for the Health Advisory Board, Agriculture and Nutrition Advisory Board and the Vaccine and Industrial Biotechnology Committees. Phil works with member companies to develop industry-wide responses to government initiatives and to communicate industry priorities to federal decision makers. Phil also serves as a member of the Multi-Sector Advisory Committee for the Pan-Provincial Vaccine Enterprise (PREVENT).

Prior to joining BIOTECanada, Phil served as Director of Programs at Genome Canada, where he coordinated the scientific review processes for competitive programs across the spectrum of genomics and proteomics research.

For over 6 years, Phil served as a Science Policy and Legislative Affairs Advisor at the US Department of Agriculture in Washington, DC where he was responsible for developing research and education policies and programs related to agricultural biotechnology, food safety, andnatural resources. Prior to his appointment at USDA, Phil was a professional staff member on the US Senate Committee on Agriculture for Senator Tom Harkin of Iowa, and a Legislative Aide in the Offices of Representative Earl Pomeroy of North Dakota and Senator Tom Daschle of South Dakota.

Dr. Schwab holds a Ph.D. and M.S. in Plant Breeding and Genetics with a minor in conservation biology from the University of Minnesota and a B.S. degree from Michigan State University.

Brian Underdown, PhD

Brian focuses on investments in North American therapeutics companies at all

stages of development. With over 12 years of investment and operational
experience in the biopharmaceutical sector, he has been a key player in the growth of over 10 life science companies in Canada and the US.

Located in our Toronto office, Brian joined our firm in 1997. Before joining Lumira Capital, Brian was assistant vice president research at Pasteur Merieux
Connaught (PMC) from 1994 to 1997, where he was responsible for the Canadian Universities Research program and several global vaccine development
programs. During his academic career, Brian was associate dean, research at the University of Toronto's Faculty of Medicine and at the Faculty of Health Sciences at McMaster University. Brian has published over 85 articles in immunology in numerous peer review publications.

Brian obtained his PhD in immunology from McGill University at Montréal, Québec, and undertook post-doctoral studies at Washington University School
of Medicine at St. Louis, Missouri, where he focused on immune-mediated diseases and vaccine development.
Brian's past or current board positions and investment responsibilities include: Argos Therapeutics, Ception Therapeutics, Cytochroma Inc., Golden Horseshoe Biotechnology Network, ID Biomedical, Nysa Membrane Technologies, Trillium Therapeutics, Transmolecular Therapeutics and Viron Therapeutics.

Actively involved in many government sponsored research organizations at the board and advisory level, Brian's participation includes: Allergen and
CANVAC, Canadian National Centres of Excellence in Asthma and Vaccines, and the Ontario Genomics Institute.

Rachel Woen [Moderator]

Innovation commercialization: From bench to market

Tom Brzustowski, PhD
Tom Brzustowski is RBC Professor in the Telfer School of Management of the University of Ottawa. He is also Chair of the Board of the Institute for Quantum Computing at the University of Waterloo. His recent book: "The Way Ahead - Meeting Canada's Productivity Challenge" was published by the University of Ottawa Press in 2008.
Dr. Brzustowski was President of NSERC from 1995 to 2005. A registered professional engineer (P.Eng.), Brzustowski taught mechanical engineering at Waterloo from 1962 to 1987, and also served as Vice-President, Academic of the University from 1975 to 1987. After that he was Deputy Minister of Colleges and Universities and later of the Premier's Council in the Government of Ontario.

Tom Brzustowski is an Officer of the Order of Canada and holds honorary doctorates from numerous Canadian universities. In 2006, he was awarded the Gold Medal of Professional Engineers Ontario.

Abstract:
The commercialization of new goods and services that have their roots in university research has the potential to improve our productivity and enhance our wealth creation to a significant extent by helping move Canadian industrial production higher up on the value chain. However, in spite of growing expertise and some singular successes, it is becoming increasingly clear that to realize this potential it will be necessary to shift the focus of our S&T policy closer toward wealth creation as an explicit goal, so that commercialization might no longer be dealt with as an afterthought in the research enterprise, and its scale might be greatly expanded.

The presentation proposes some elements

of a "wealth creation" S&T policy, describing what they might make possible, and how. The proposals incorporate several existing programs as the foundation, and make use of some recent findings on industrial R&D in Canada.

Ronald Dyck, PhD

Dr. Ronald Dyck was appointed the Assistant Deputy Minister Research Division, Alberta Innovation and Science in June 2000 (now called Alberta Advanced Education and Technology). In this role, he provides leadership and oversight to five research institutes, (Alberta Energy Research Institute, Alberta Agricultural Research Institute, Alberta Forestry Research Institute, Alberta Life Sciences Institute, Alberta Information and Communications Technology Institute), the University Research and Strategic Investments, nano Alberta, and Innovation Policy. In addition he has provided leadership to the development of Alberta's nanotechnology strategy.

Dr. Dyck also was appointed as the Board Secretary to the Alberta Science and Research Authority, Alberta's advisory body, that provides strategic advice to the Government of Alberta through the Minister of Advanced Education and Technology for the ongoing development of science, research, technology and innovation.

Over the past twenty-four years, Ron has held several positions within government including Executive Director, Policy & Planning Services Division, Director of Health Policy, Director of Health Planning, and Director of Prevention & Promotion.

Abstract:
Innovation happens in most areas of our experience, from the way in which we solve small challenges in our homes or at work, developing new "tools" in the garage, to developing new technology solutions to major challenges in our industries. Such areas as the quality of deal flow, seed and venture capital requirements, the policy and regulatory barriers and the lack of management talent have been identified, described and debated. What appears to have received less emphasis is the need for an integrated, systems approach to the innovation cycle that enhances the interactive nature of idea generation, knowledge creation and the journey of bringing research and technology to market. This presentation will focus on Alberta's recent research and innovation "renovation" that aligns and facilitates the coordination of strategies, funding, knowledge creation, technology development and commercialization into an integrated system.

Jorge Niosi, PhD

Jorge Niosi is Professor in the Department of Management and Technology at the Université du Québec à Montréal since 1970 and Canada Research Chair on the Management of Technology since 2001. He is the author, co-author, editor or co-editor of 14 books published in Argentina, Canada, France, the United Kingdom and the United States, as well as some 60 articles in refereed journals including the Cambridge Journal of Economics, Industrial and Corporate Change, Journal of Business Research, Journal of Development Studies, Journal of Technology Transfer, Management International Review, Research Policy, R&D Management, Small Business Economics, Technovation and World Development. He has been guest editor of several journals including the Journal of Development Studies, Journal of Technology Transfer, Research Policy. He is a Fellow of the Royal Society of Canada (Academy N. 1) since 1994, and appears in the Canadian Who's Who, the International Authors and Writers Who's Who (UK) and Contemporary Authors (USA). He has been a Visiting Scholar at Stanford University, a Visiting Professor at the Université de Paris on

several occasions, a Fulbright Fellow, and has received several awards, including the John Porter Award. His work is widely cited. He has consulted for UNIDO, CIDA, IDRC, Industry Canada, Statistics Canada and other national and international agencies.

Abstract:
Since World War II Canada has built a national system of innovation that includes world-class research universities, government laboratories, science, innovation and technology policy incentives, as well as thousands of innovative small firms, many of them spun off its research universities. However, the number of large innovative high-technology enterprises (SMEs) is small. The presentation suggests that Canada's NSI needs to be upgraded with new incentives aimed at allowing high-tech SMEs to cross the "valley of death". The US and Japan offer some interesting schemes that Canada should consider adopting.

Mark Romoff

Mark Romoff joined the Ontario Centres of Excellence (OCE) Inc. as President and CEO in fall 2004. He is a career foreign service professional with a strong track record for advancing the competitive interests and opportunities for Canadian companies internationally.

Mr. Romoff's Foreign Service career started with assignments in Malaysia, Mexico and Nigeria. From 1992 to 1996, he was Minister-Counsellor in the Canadian Embassy in Tokyo with responsibility for Canada's trade with Japan. In 1996, he became Consul General in Buffalo, New York, where he helped improve trading relationships and established the basic policies governing cross-border trade between U.S. and Canada.

In 2002 Mr. Romoff was seconded to the federal Industry department, as Executive Director of the Ontario Region. Among other things, he was responsible for building the export readiness of Ontario companies and for encouraging foreign investment in Ontario.

Mr. Romoff has a B.A. in Mathematics from McGill University, and a master's in Applied Science from the University of Waterloo. Mark and his wife, Shelley, live in Toronto with their daughter, Alana.

The next generation of scientists

Kathleen Bloom, PhD [Moderator]

Kathleen Bloom is President and CEO of Knowledge Impact Strategies Consulting Ltd. Knowledge Impact Strategies provides innovative methods and products that connect researchers and their findings with policy makers, practitioners, and civil society. She is also a faculty member at the University of Waterloo, and consults to governments, NGOs, and research institutes on strategic planning, implementation, and assessment of knowledge transfer investments. Dr. Bloom is co-founder and Chair of the Board of the Canadian Centre for Knowledge Mobilisation, and founding member of the Ontario Ministry of Education Research Panel. In 2004 she created Research Works!, a community-university research alliance funded by the Social Sciences and Humanities Research Council, and in 2008 she initiated Canada's first Science Shop, a community service centre for knowledge transfer at the University of Waterloo.

David Castle, PhD

Dr. David Castle is Canada Research Chair in Science and Society at the University of Ottawa. He is appointed to the Faculty of Arts where he is an Associate Professor in the Department of Philosophy, and holds a cross appointment to the Faculty of Law (Common Law Section). His interests include the philosophy of the natural sciences, social aspects of new technology, especially biotechnology and genetics, and science and society. His research currently focuses on the interaction between science and society, including democratic engagement, regulation and governance, and intellectual property and knowledge management. He has published dozens of peer-reviewed articles and book chapters and several books on the social dimensions of science, technology and innovation. Castle has held several major research awards, and has considerable experience leading strategic research initiatives and research project management. In addition, he has consulted widely to government on such issues as the impact of national technology transfer policies and programs, intellectual property strategies for the health research and development sector, and the role of non-scientific considerations in the regulation of science and technology. Castle also acts as a consultant to life sciences industries.

Abstract:

Science literacy is a public policy issue. Conventionally, this is understood as science literacy for a population expected to participate in a knowledge based economy in which science and technology innovation assumes a greater role in wealth creation. How science literate are Canadians, and, perhaps more importantly, how well are we equipped to measure literacy? The answers have implications not only for the development of scientific and technologic competency in researchers and entrepreneurs, but has parallel implications for the electorate and public officials.

Ramin Jahanbegloo, PhD

Ramin Jahanbegloo is a well-known Iranian-Canadian philosopher. He received his B.A. and M.A. in Philosophy, History and Political Science and later his Ph.D. in Philosophy from the Sorbonne University. In 1993 he taught at the Academy of Philosophy in Tehran. He has been a researcher at the French Institute for Iranian Studies and a fellow at the Center for Middle Eastern Studies at Harvard University. Ramin Jahanbegloo taught in the Department of Political Science at the University of Toronto from 1997-2001. He later served as the head of the Department of Contemporary Studies of the Cultural Research Centre in Tehran and, in 2006-07, was Rajni Kothari Professor of Democracy at the Centre for the Study of Developing Societies in New Delhi, India. In April 2006 Dr. Jahanbegloo was arrested in Tehran Airport charged with preparing a velvet revolution in Iran. He was placed in solitary confinement for four months and released on bail. He is presently a Professor of Political Science and a Research Fellow in the Centre for Ethics at University of Toronto and a board member of PEN Canada. He has published twenty books in English, French and Persian.

Abstract:

Albert Einstein used to say that science without religion is lame, religion without science is blind. We can also add that: Science without democracy is arbitrary, as democracy without science is ignorant. The interface between democracy and science has always been a complex and problematic one which, to be properly understood, must be situated in relation with a third concept which is nonviolence. Viewed from this perspective, democratic theory continues to challenge scientists in particular and science in general to re-think and re-conceptualize the idea of science as a way of reducing violence in our world. However, it goes without saying that

democracy is also in a great need of scientific reasoning to promote effective choices. Science Scientific developments aimed directly at achieving nonviolence are the most valued by democratic experience. Science today offers much support for nonviolence as an inherited, but largely undeveloped capacity of human nature. However science needs to have a goal of nonviolence to bring desired change.

Sunny Marche, PhD

Sunny Marche is a certified management consultant (CMC), with almost 25 years of consulting experience in a wide variety of areas, and is currently a Professor, MIS at Dalhousie University and the Associate Dean in the Faculty of Graduate Studies. The university appears reluctant to expose him to undergraduate students, notwithstanding the fact he has won a number of teaching awards. His final degree was a Ph.D. in information systems from the London School of Economics.

Sunny has a special reputation among his clients for being able to help them to identify reasonable goals and objectives, and to develop practical strategies for achieving them. He has had significant experience in technology assessment for investment decision making given that he is a recovering venture capitalist. He has also participated on the Boards of Directors of public and private organizations in Canada.

Abstract:
"The Resistible Rise of Opinion: A Call to Scientific Arms"

Something pernicious and problematic has arisen in our society – it is the triumph of opinion. It begins with the implicit expectation that opinions are worth something in the first place, and there is no real need for due consideration of the evidence or the application of critical thinking as a process. It ends with the notion that every opinion is worth as much as every other opinion.

Scientific thinking generally and science specifically are important antidotes to this unfortunate development in our culture. The challenge is how to develop scientific literacy in the face of so many other demands for literacy (e.g., information literacy, computer literacy, multimedia literacy, ecological literacy, etc.). What are the necessary conditions for developing a minimum scientific competency among Canadians?

David Rose, PhD

David Rose has been Professor and Chair of the Department of Biology at University of Waterloo since January, 2009. Previously, he was a Senior Scientist at the Ontario Cancer Institute and a Professor in the Department of Medical Biophysics at University of Toronto for 18 years. He also worked for 7 years in the National Research Council laboratories in Ottawa.

Abstract:
Traditionally, the North American educational systems, from primary right through post-secondary, have placed less emphasis on science than those of many other countries in Europe and Asia. As a result, the general public (the electorate) often has less appreciation for the contributions of basic science to the economic and social problems of society. The establishment and acceptance of a national science policy requires not just the support of the general public, but the active promotion of such a policy by the electorate. This level of public engagement, and the associated pressure on Governments to formulate policies promoting basic research, requires a re-emphasis in educational curricula of science: not just the facts but the broad relevance to society's issues.

Bonnie Schmidt, PhD [Moderator]
Dr. Bonnie Schmidt is the founder and President of Let's Talk Science, a national charitable organization dedicated to improving science literacy. She began her science outreach activities in 1991 while completing her doctoral degree in physiology at The University of Western Ontario. Upon graduation in 1993 she formally launched Let's Talk Science.

Bonnie has been active in many national and provincial organizations and initiatives. She currently serves as the founding President of the Science & Technology Awareness Network (STAN) and is a Director of the Ontario Genomics Institute. She recently served as a member of the Ontario government's Early Learning Experts Panel and has served on various grant selection committees. She has organized sessions on science outreach at national and international academic conferences and has been an invited speaker at numerous science and education forums, including the 2006 OECD Conference on Global Science, "Declining Student Enrolment in Science & Technology". She has published several academic papers and abstracts on her research into informal science learning.

For her efforts in education, Bonnie has received several awards, including the Top 40 Under 40; Queen's Golden Jubilee Award; Ontario's "Leading Women, Building Communities"; YWCA's Woman of Distinction; and UWO's Young Alumni Award.

The Democratization of Science

Elana Brief, PhD
Dr. Elana Brief is a scientist and science advocate. She was awarded her doctorate in physics from the University of British Columbia (UBC) where she where she developed methods for using MRI (Magnetic Resonance Imaging) to non-invasively measure concentrations of chemicals in human brain. During her post-doctoral fellowships she used similar techniques to study human lung in Paris, France and fabricated skin at Simon Fraser University (SFU). She continues to publish her medical imaging work and collaborates with physicists, radiologists, dermatologists, endocrinologists and neurologists at SFU and UBC. In addition, she works as a scientific consultant for the National Core for Neuroethics and as a Research Director with the Women's Health Research Network. In June 2009, Dr. Brief co-authored and published "Our Common Ground: Cultivating Women's Health through Community Based Research" – a guide for research collaborations between academics and non-academics. She is the President of the Society for Canadian Women in Science and Technology (www.scwist.ca) and invests her energy in science promotion and in advancing women and minorities in science, engineering and technology.

Abstract:
The inclusion of women in science and engineering is an example of a democratizing change in science practice. She will distinguish between science outreach activities and true scientific engagement to suggest ways in which a greater diversity of people might guide and influence science.

Hiromi Matsui
Hiromi Matsui was born in a BC internment camp organized by the Canadian government to remove Canadians of Japanese ancestry away from the coast during World War II. The experience of being part of a community that was uprooted led to her interest in power structures in large organizations and to the contribution that women make to the economy.

She studied at the University of Waterloo and the London School of Economics where

she focused on the contribution that working women make to the economy. She is the former Director, Diversity and Recruitment in the Faculty of Applied Sciences at Simon Fraser University and is Co-Chair of the Women in SETT project of CCWESTT. She is an advocate for the retention and promotion of women in science and technology and is currently based in the IRMACS Centre, an interdisciplinary research centre at Simon Fraser University.

Abstract:
Her talk will review a range of interpretations of what the democratization of science means to different communities and how this relates to science policy. She will discuss the roles of academic researchers, government bureaucrats and science policy specialists, noting the fundamental value differences in these systems and the challenges arising from structural barriers to communication.

How does the democratization of Science lead to good science policy? Canada takes pride in its democratic governance but falls well behind many countries in terms of innovation and productivity measures. The Canadian labour market has a high proportion of educated, skilled workers, who could contribute to the growth of the Canadian economy, but what are the key factors inhibiting the full use of Canada's human resource potential? The democratization of science can place Canada in a more competitive place in the global economy but national leadership is needed to effect this change.

Marc Saner, PhD

Marc Saner is the Executive Director of the Regulatory Governance Initiative at the School of Public Policy and Administration, Carleton University (www.regulatorygovernance.ca) and Principal, Saner Consulting (www.saner.ca). He has more than 15 years of experience carrying out assessments and analytical work in the natural sciences and humanities. For the last decade, his primary interest has been the intersection of governance, ethics and science. Prior to his current consulting work he was the Executive Vice President and Director of Assessments at the Council of Canadian Academies and a Director at the Institute On Governance (an Ottawa-based think tank). He is currently an Adjunct Research Professor at the Departments of Philosophy and Biology at Carleton University.

Abstract:
The times when lab-coated scientists could sell the public anything from light cigarettes to funding requests for nuclear-powered family cars are in the distant past. For decades, the political trend has been toward increased public engagement in the design, production, and use of science. This poses a fundamental problem: is it not a contradiction in terms to make special knowledge (science) everyone's business?

I propose to sharpen our discussion by focussing on two projects that are related to the broader goal of rendering science more democratic: (1) The governance of risk management and regulation, and (2) the governance of modern technology. In both cases, a key challenge lies in the navigation of the interface between (a) facts and science and (b) values, ethics and, ultimately policy. I will provide an analysis of how much input to each of the two sides of this interface we can reasonably expect and accommodate from the broad or organized public.

Science journalism, media and communication

Chantal Barriault MSc

Chantal Barriault MSc is Science North's Co-Director of the Science Communication Graduate Diploma Program, offered jointly with Laurentian University. She also leads Science North's Research and Evaluation initiatives. In 2006 Chantal was recognized by the Canadian Association of Science Centres with its first Outstanding Leadership Award for her work in developing the Science Communication program.

With a background in Psychology and Biology, Chantal received a Master's degree in Science Communication from the University of Glamorgan in 1999. Her research on understanding how visitors learn in science centres has received international attention.

Prior to 2005 Chantal was responsible for Science North's education programs for schools, developing and delivering in-service training workshops for teachers in French and English in all sections of Ontario's Science and Technology curriculum.

Abstract:
There are good democratic reasons for increasing public participation in the development of policy with respect to science and society issues such as nanotechnology, alternative energy, biotechnology, and greenhouse gas reduction. The decline in voter turnout during recent elections may reflect people feeling disconnected from the policy making process. Lack of participation also leaves the public poorly prepared to consider new policy proposals – the "Greenshift" for example.

Communication and public engagement have an important role to play in creating a culture or mindset in which people understand science based decisions in policy and decision making, and in giving voice to public views of science based issues. What mechanisms of public engagement are likely to be the most effective?

Long term strategies can include supporting and working with the Informal settings of science centres and museums. These provide a neutral space for such engagement to flourish. A more short term strategy to involve the public should include Citizen Forums, which are a more structured engagement for recommendations into the policy making process and are widely used in other countries.

Peter Calamai

Peter Calamai is a freelance newspaper and magazine writer and an adjunct research professor at Carleton University's School of Journalism and Communication. Calamai worked for 30 years as a reporter and editor with the now-defunct Southam newspapers. A 1965 B.Sc. physics graduate from McMaster University, he was the national science reporter for Southam News from 1973 to 1977 and filled a similar post for The Toronto Star from 1998 to 2008, both times based in Ottawa. A founder of the Canadian Science Writers' Association, Calamai is also a director of the Science Media Centre of Canada. He has been honoured for science journalism by the Canadian Association of Physicists, the Royal Canadian Institute, the Geological Association of Canada and the American Meteorological Society. As well Calamai is a three-time winner of National Newspaper Awards for spot news reporting and feature writing.

Abstract: "Decline and Fall: The sorry state of science policy reportage in Canada"

It is now commonplace to bemoan the disappearance from the mass media in

Canada of journalists who specialize in reporting about science, leaving either a vacuum or ill-equipped general-assignment reporters to try to fill the gap. Despite claims of a New Jerusalem by its proponents, the Internet is largely providing a plethora of sites engaged in special pleading, advocacy and propaganda concerning frontier research issues.

Overlooked in this hand-wringing is an absence at least as troubling to the ideal of informed public debate. Reporting and commentary on matters of science policy is rare in the mass media and sporadic even in publications specializing in public policy. Yet in the 1970s, Science Forum journal provided not only insightful commentary on science policy issues but first-hand investigative reporting. This presentation by an Ottawa correspondent for Science Forum will examine the reasons for this decline and fall.

Mark Henderson

Mark Henderson is a journalist specializing in topics relating to Canadian science and technology and research and development. Since 1994, Mr. Henderson has been the editor of RE$EARCH MONEY, a national newsletter focused on Canadian science and technology policy and funding issues. RE$EARCH MONEY features articles on business R&D spending, academic research and government policy and funding programs pertaining to R&D. Mr. Henderson holds an Honours Bachelor of Journalism from Carleton University and a Honours BA in Film Theory from Queen's University. Over the past 30 years, he has written for a wide range newspapers, magazines, government departments and agencies and corporations.

Nicola Jones

Nicola Jones is a commissioning editor for Nature's opinion section, the science journalist in residence and an adjunct professor at UBC's School of Journalism, and an award-winning reporter. She obtained a combined honours BSc in chemistry and oceanography from UBC, before switching career streams and gaining a Masters in Journalism, also from UBC. She worked as a reporter with New Scientist magazine in London for 3 years, before moving on to the science journal Nature, where she was by turns a news and features editor, the online news editor, and an essays editor. She has written or edited more than 3,000 articles during her career thus far, and travelled from the Arctic to Africa in pursuit of stories.

Abstract:
The editor in chief of Nature can often be heard saying "Canada punches above its weight in science; we should be paying more attention." Since returning to my native land after a stint of 10 years in the UK, I have been trying to do just that – paying more attention to Canada. The result has been a greater appreciation of local science (and a marked increase of the word 'Canadian' in Nature's pages), but also some disappointment, both from the complaints I hear about policy from Canadian scientists, and from the apparently limited supply of media 'watchdogs' on the scene.

In the UK, I had the opportunity to grow from being a 'science writer' to a 'science journalist', from someone who wrote for print to someone devoted to the web, from a writer of 'objective truths' to an editor of opinions. And working with Nature has exposed me to leaders in the worlds of online publishing and scientific debate. Many of these experiences have echoed changes in the broader world of journalism, and may help to shed some light on how the 'outside world' sees Canadian science and science policy.

Paul Wells [Moderator]

As Senior Columnist for Maclean's magazine, Paul Wells is one of Canada's foremost political commentators.

Fresh, funny and authoritative, he was hailed by Robert Fulford as "a first-class Ottawa reporter." His first book, Right Side Up: The Fall of Paul Martin and the Rise of Stephen Harper's New Conservatism was a national bestseller. He has written for Time magazine, the National Post, La Presse and the Literary Review of Canada. His blog, "Inkless Wells", is required reading in Ottawa and wherever people spend too much time worrying about politics.

A veteran television and radio commentator whose insights have educated and entertained audiences in French and English, Wells is returning from a year in Paris as Maclean's Europe correspondent, where he reported from Germany, Poland, the UK, Afghanistan and Pakistan.

Born in Sarnia, Ontario, Paul studied at the University of Western Ontario and the Institut d'Etudes politiques de Paris. He is on the Advisory Committee of the new Glendon School of Public Affairs and is a Fellow of the new School of Public Policy and Governance at the University of Toronto.

Best practices in science policy from other countries

Alex Bielak, PhD

Dr. Alex Bielak is Environment Canada's first-ever Director, Science and Technology Liaison. He leads a dynamic group whose mission is communicating science knowledge to targeted audiences and linking science with policy development. A key architect of EC's new Publishing Policy and S&T online presence, his group has developed an acclaimed suite of innovative knowledge translation and brokering tools and approaches, including searchable databases of EC Scientists (EC S&T Expert) and Publications (EC Science Alert). Prior to his current assignment, this "salmon biologist gone wrong" spent over a year as A/Director General, S&T Strategies Directorate in EC's new S&T Branch, where he set up the Directorate and led the team developing the Department's new Science Plan. A NATO Scholar, he previously held senior positions with the National Water Research Institute, NGOs, and other federal and provincial government departments. Alex is a dynamic and widely published speaker and an alumnus of the Banff Centre's inaugural Science Communications Residency (program led by Jay Ingram). His expertise is sought in Canada and internationally as an authority on science communications, and knowledge translation and brokering. He serves on numerous Boards and Committees and recent recognition of his professional and volunteer activities includes a University of Waterloo Science Faculty "Distinguished Alumni Award" on the occasion of UW's 50th Anniversary.

Abstract:

Improving the science-policy interface continues to attract international interest and there is increasing recognition of the important role of knowledge-brokering intermediaries in bringing these distinct communities together. Based on concrete examples, this presentation rejects this session's premise, that "Canada lags behind the rest of the world," at least as far as this part of the science-policy equation is concerned: Much can be achieved by individuals or small groups with relatively few resources, and we suggest a path forward for the international community to build on and contribute to Canadian experience in this domain.

Margaret Dalziel

Margaret Dalziel is an associate professor of innovation and entrepreneurship at the Telfer School of Management of the University of Ottawa. Margaret joined the University of Ottawa in 2001 with 15 years experience in technology development and research management at McGill University, PRECARN (an industrial research consortium), and the Canadian Space Agency. She conducts research on innovation intermediaries, industry architecture, and alliances and acquisitions in technology-intensive industries. Her research has been generously supported by the Social Sciences and Humanities Research Council of Canada, and results have been published in leading journals such as Research Policy, the Journal of Engineering and Technology Management, and the British Journal of Management. During 2008-2009 Margaret was a visiting professor at Zhejiang University in Hangzhou, China. In 2009, she and Brian Barge founded The Evidence Network (www.theevidencenetwork.com), a company that addresses the performance measurement needs of innovation enablers.

Abstract: "Innovation Policy in China"

Because firms and universities face such strong pressures to conform to international standards, a country's innovation policy may be most strongly reflected by its innovation intermediaries. Innovation intermediaries such as research institutes and networks, science parks, business incubators, and industry associations support innovation and knowledge exchange, and may do so in ways that uniquely reflect a country's history, culture, and values. China is home to almost 4000 research institutes, 53 science parks, 50 university science parks, 534 technology business incubators, and hundreds of industry associations. Innovation intermediaries in China tend to take a property-based approach, relying on co-location to create coordination, identify, and learning benefits, and drawing on the legacy of the "danwei" of earlier generations. My presentation will provide an overview of the evolution of innovation intermediaries in China over the last 30 years, and will raise some questions about how Canada's legacy is reflected in its current system of innovation.

Kei Koizumi

Kei Koizumi is Assistant Director for Federal Research and Development at the White House Office of Science and Technology Policy (OSTP). Koizumi joined OSTP in mid-February after having served on the Obama transition team as part of the Technology, Innovation & Government Reform Policy Working Group.

Before joining OSTP, Koizumi served as the longtime Director of the R&D Budget and Policy Program at the American Association for the Advancement of Science (AAAS). While at AAAS, he became known as a leading authority on federal science and technology funding and budget issues and was a frequent speaker to public groups and to the press.

Koizumi received his M.A. from the Center for International Science, Technology, and Public Policy program at George Washington University, and received his B.A. in Political Science and Economics from Boston University.

Abstract:

In 2009, the United States transitioned between the Bush Administration and the Obama Administration. The (US) White House Office of Science and Technology Policy (OSTP) is responsible for leading the formulation and implementation of science and technology policy within the US government and carrying out Administration priorities through the application of science and technology policy. The Obama Administration is committed to harnessing S&T to make progress on the four national priorities of

economic recovery and growth; dealing with the interrelated challenges of energy, the environment, and climate; a healthier American people; and a secure America within a global world. To accomplish these goals, OSTP is prioritizing financial resources for R&D, but also attempting to implement new science policy practices. The presentation will highlight some signature Obama Administration science policies, including: transformative or high-risk research within a use-inspired framework, the use of information technology to advance open government goals, 'science of science policy' tools for evaluating R&D investments, and a comprehensive approach to encouraging the transition toward a low-carbon economy.

Tony McBride

Tony McBride, Head of Strategy, The Royal Society Science Policy Centre, United Kingdom

Tony joined the Royal Society (the UK's national academy of science) as Innovation Policy Manager in March 2007 and managed the combined Science Base and Innovation portfolio from March 2008. He became the Science Policy Centre's Head of Strategy in June 2009. Before joining the Society, Tony was a Senior Policy Adviser at the Confederation of British Industry working on innovation, science and technology policy (2004-2007). Prior to this Tony worked in a variety of roles in the UK charity sector.

Tony recently completed work on 'Hidden Wealth: the contribution of science to service sector innovation', published in July 2009. He and colleagues are currently working on a major study which will assess the long-term direction of UK science and innovation policy. 'The Fruits of Curiosity: science, innovation and future sources of wealth' will consider the role that science will play in equipping Britain to meet future economic, social and environmental challenges and the different forms of value created by science, engineering and medicine for the UK's economy and society.

Sun Yongjian, PhD

Currently Science and Technology Consul with the Consulate General of the People's Republic of China in Toronto, a position he has held since the start of this year, Mr. Yongjian has also served as Deputy Director at the rank of Division Director, Division of Legislation and Intellectual Property Rights, in the Department of Policy, Regulation and System Reform, Ministry of Science and Technology. As Deputy Director, his responsibilities included researching and drafting science and technology laws, legislation and regulations as well as drafting policies related to the IPR's protection policies related to science and technology. Previously, Mr. Yongjian served as Deputy Director of Soft Sciences, Department of Policy and Regulation, The State Science and Technology Commission (the former Ministry of Science and Technology), involved in the organization and implementation of the national soft sciences research programme, the administration of China Soft Sciences Association and China Soft Sciences magazine.

Trained as an Engineer, he worked at the Beijing Institute of Information, and was involved in the study of Chinese population control and quality. Mr. Yongjian holds a Bachelor of Arts and a Masters Degree from the Harbin Institute of Technology, China.

Brian Wixted

Brian worked for the Australian Commonwealth Public Service on science, technology and innovation indicators analysis (1989- 1995) and science and innovation policy (1995-2000). Between 2000 and 2004, he was with the University of Western Sydney, where he worked on a number on research system evaluation projects as well as innovation systems studies. Since moving to BC in 2004, Brian

has worked on a number of evaluation related projects including one for the Provincial Government.

Abstract:
With an increasing drive by governments for the sciences to address problems of relevance to economic and social issues, developed nations have increasingly chosen to create new models for funding their national S&T programs. Many of these models revolve around the formation research teams, or networks, that cross geography and which are interdisciplinary. But do these forms of funding work and for whom do they work? Which problems get funding and why? What impact do they have? Who are the stakeholders and how well do the networks interact with them? These are the primary questions behind an ongoing research project into evaluation strategies for research networks which is part of the SSHRC research Impacts Initiative. Our work sheds light on the critical questions of stakeholder engagement and the differences between research networks in the social sciences, natural sciences and health sciences.

Science diplomacy and international cooperation

Paul Dufour
Paul Dufour is currently based at Natural Resources Canada, on executive interchange from the Canadian-based International Development Research Centre. He was previously the interim Executive Director at the former Office of the National Science Advisor in the federal Government advising on international S&T matters and broad questions of R&D policy directions for the country.

Born in Montreal, Mr. Dufour was educated at McGill, the Université de Montreal and Concordia University in the history of science and science policy, and has had practical S&T policy experience for over three decades having been with such bodies as the Science Council of Canada, Ministry of State for Science an Technology, Foreign Affairs, and adviser to the Prime Minister's Advisory Council on S&T.

He lectures regularly on science policy, has authored numerous articles on international S&T relations and Canadian innovation policy. He is series co-editor of the Cartermill Guides to World Science and past North American editor to Outlook on Science Policy.

Abstract: "Beavers, Dragons, and Eagles--Reflections on using science for global branding"

Diplomacy is an oft- underrated and understated tool for developing science partnerships around the world. Some nations have developed a strong capacity to blend their trade, investment, culture and science into seamless aspects of foreign policy. Canada has a rich industrious tradition in science and knowledge partnerships, but seems to be losing its focus and ability to use knowledge more strategically in helping address global issues as well as shape its national image as a key R&D partner. These remarks will focus on what other countries have been doing in this arena and how Canada can better develop its S&T capacity as a leveraged global currency for future development at home and abroad.

Kevin Fitzgibbons [Moderator]
Kevin Fitzgibbons is the Director of the Innovation, Science and Technology Division of the Department of Foreign Affairs and International Trade. Previous to joining the Department in August 2007, Kevin was the Executive Director of the Office of the

National Science Advisor. From 1991 to 2004 Kevin worked as a strategic planning and policy analyst at the National Research Council of Canada. He has a Masters degree in Political Economics from l'Université de Montréal.

Alidad Mafinezam, PhD

Dr. Alidad Mafinezam is co-founder of the Mosaic Institute in Toronto, an organization focused on harnessing Canada's ethnic and cultural diversity for international peace and development. He has worked as a consultant to the International Development Research Centre, the UN-mandated University for Peace, the Geneva-based Centre for Applied Studies in International Negotiations, among other organizations. He has worked as a program director at the School of International and Public Affairs at Columbia University, the Atlantic Council of the United States, and the Center for Urban Policy Research. He has taught upper-year public policy courses at the University of Toronto at Scarborough. He received his BA from the University of Western Ontario, and Masters and Ph.D. degrees from the Edward J. Bloustein School of Planning and Public Policy at Rutgers University, where he wrote a dissertation on the history and current condition of American think tanks.

Abstract:
This paper provides an overview of the potential of scientists in the diaspora who hail from the developing world to transfer some of their skills back to their countries of origin, and thus act as agents of development in such countries. I examine the successful record of India, China, and the Philippines in harnessing the potential of their expatriate communities, and contrast their success with the relatively unsuccessful record of African countries in this area. The main argument of the paper is that in the absence of an institutional infrastructure that can benefit from the skills of their diaspora, the talents of such diaspora communities will not be effective in significantly improving the development prospects of the poorest countries of Africa, Latin America and Asia. This creates new challenges for the development agencies of industrial countries such as Canada, the US, and European countries, and it should compel them to add "brain circulation" to their broader development activities aimed at building a knowledge and research infrastructures in the developing world.

Monali Ray

Monali Ray is a PhD candidate at the Institute of Medical Science, University of Toronto. She completed her Bachelor of Health Sciences (Hons) at McMaster University. Monali's thesis work is exploring Canada's research and entrepreneurial collaboration with India and Brazil in the field of health biotechnology.

Abstract:
The aim of the case study is to analyze factors and conditions that influence Canada-India collaboration in the field of health biotechnology. In recent years India has been encouraging research capacity development in health biotech and also fostering a nascent health biotechnology private sector. We have also seen that health biotechnology firms and researchers in Canada and India have started to build linkages with each other and we want to gain deeper insights into what is the potential value of these relationships, and what are some of the complications encountered. We conducted in-depth interviews with partnering Canadian and Indian researchers as well as firms to gain understanding of the main reasons for initiating the collaborations, the challenges encountered and the impacts achieved. We also interviewed policymakers and wider actors – regulatory agencies, venture capitalists, funding agencies, intellectual property experts – in both Canada and India to see how aligned their innovation systems are to encourage joint research and

development in health biotechnology. Preliminary analysis suggests that motivations for partnering for both the Canadian and Indian sides include gaining access to each other's markets, risk reduction in product development and accessing complementary scientific expertise. Indian partners cite multicultural aspects of Canada to be a reason they feel comfortable in their partnerships with Canadian organizations and firms. A barrier to increasing collaboration between Canada and India in the health biotech field is the lack of awareness the two sides have of each other. Paucity of historical civil society and trade ties between Canada and India has led to the two sides not being attuned to each other's capabilities and strengths. Joint knowledge creation and achieving key milestones in product development include some of the outcomes of Canada-India collaboration in health biotechnology.

Halla Thorsteindóttir, PhD

Dr. Halla Thorsteinsdóttir is an Associate Professor at the Dalla Lana School of Public Health, University of Toronto and a member of the McLaughlin-Rotman Centre for Global Health, University Health Network. She completed her doctoral studies in Science and Technology Policy in 1999 at SPRU – Science and Technology Policy Research, University of Sussex, United Kingdom. Prior to that, she completed a master's degree in Development Economics from the Norman Paterson School of International Affairs at Carleton University in Ottawa Canada as well as a master's degree in Psychology from the same university. Halla's research is focused on health biotechnology innovation in developing countries. Her current projects examine collaboration in health biotechnology both between Canada and developing countries (north-south collaboration) and amongst developing countries (south-south collaboration) as well as regenerative medicine innovation systems in several emerging countries. Halla is the recipient of the Canadian Institutes of Health Research, Institute of Genetics Maud Menten New Principal Investigator Prize (2005-2006) and the Canadian Institutes of Health Research, New Principal Investigator Award (2007-2012).

Abstract:
The presentation will look at the rationale for Canada's collaboration with developing countries in the health biotechnology field and present results of studies that mapped both research and entrepreneurial collaborations. Co-authored papers by researchers from Canada and at least one low and middle income country were used as a proxy for research collaboration and we analysed the levels and patterns of the linkages. To map Canada's entrepreneurial collaborations, we surveyed all health biotech firms we could identify in Canada and asked them about the levels and characteristics of their linkages with low and middle income countries. We will compare Canada's north-south collaborations with collaborations of other high income countries with developing nations and discuss what the comparisons imply about Canada's roles in international health biotechnology networks.

Caroline Wagner, PhD

Caroline S. Wagner is a research analyst with SRI International in Washington DC and a research fellow at George Washington University in Washington DC.

Abstract:
Science is changing at the global level. Thomas Friedman has said that the world is now "flat." But the changes are both less and more extensive than he suggests. Despite the accelerating diffusion of scientific data, information, and knowledge, the world of science remains far from flat. Self-organizing networks that span the globe are the most notable feature of science today. These networks constitute an invisible college of

researchers who collaborate not because they are told to but because they want to, who work together not because they share a laboratory or even a discipline but because they can offer each other complementary insight, knowledge, or skills. These networks link scientists working in faraway countries through virtual ties. They also organize the constant physical churn of researchers around the world. In the twenty-first century melting pot of science, national citizenship or allegiance plays a minor role. Scientific curiosity and ambition are the principal forces at work in the new invisible college. The rise of the invisible college creates new challenges and opportunities to promote social welfare and economic growth. In particular, it gives developing countries a second chance to create strategies for tapping into the accumulated store of scientific knowledge and applying what they learn to local problems. It challenges large national players like the United States and Canada to become more flexible, adaptable, and globally focused. The U.S. government is shifting policy in this direction, and their efforts will be the focus of my remarks.

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President, Canadian Federation for the Humanities and Social Sciences
Acting Secretary of the University in 2008 and Acting Vice-President, Governance, University of Ottawa

Dr. Peter Singer, MD, MPH, FRCPC, FRSC
Director, McLaughlin-Rotman Centre for Global Health

Dr. Bonnie Schmidt, PhD
President, Let's Talk Science

Dr. Caroline Wagner, PhD
Research Fellow, Center for International Science and Technology Policy, George Washington University

Dr. Bryn Williams-Jones, Professeur PhD
Professeur, Programmes de bioéthiques, Université de Montréal

Conference Schedule

Wednesday, October 28, 2009 –Marriott Eaton Centre		
Time	**Event**	**Location**
5:00 PM	Registration Meet & Greet	Lobby, Lower Level
6:00–7:30 PM	Opening Remarks & Conference Welcome Conference Introduction Remarks by Hon John Milloy, Ontario Minister of Research and Innovation Keynote Presentation: Dr. Bruce Alberts, Editor in Chief, *Science* magazine Closing Comments & Review of Conference Format	Grand Ballroom
7:30–9:00 PM	Networking Reception	Lobby, Lower Level
Thursday, October 29, 2009 – 89 Chestnut Conference Centre		
7:30–8:30 AM	Registration Continental Breakfast	Main Lobby
8:30–10:00 AM	Opening Plenary: Canada's National Science & Technology Strategy *Alain Beaudet, Peter Singer, Heather Munroe-Blum, Christopher Paige, Moderator: Kamiel Gabriel*	Ballroom East/Centre
10:00–10:15 AM	Coffee Break	Ballroom West
10:15–11:45 AM	Plenary Session: The Canadian Economy – From Resource-Based to Knowledge-Driven *Suzanne Fortier, Peter Hackett, Peter Nicholson, Mark Lievonen, Moderator: Chad Gaffield*	Ballroom East/Centre
11:45–12:00 PM	Informal Networking Sessions; Exhibit Viewing	Ballroom West
12:00–1:45 PM	Lunch; Keynote Presentation: Preston Manning, CC, Manning Centre for Building Democracy	Ballroom East/Centre
2:00–3:45 PM	Simultaneous Panel Presentations I (3 concurrent sessions)	
	1. Lessons learned and New models for implementing scientific knowledge in decision making process *Eleanor Fast, Jeff Kinder, Bryn Lander, John Leggat, Ann McMillan, Moderator: Adam Holbrook*	Ballroom East
	2. Governance of emerging technologies *Christian Burks, Mark Fortin, Nils Petersen, Bryn Williams-Jones, Moderator: Patricia Kosseim*	Terrace East/West
	3. The Democratization of Science *Elena Brief, Ramin Jahanbegloo, Hiromi Matsui, Marc Saner, Moderator: Kathleen Bloom*	Ballroom Centre
3:45–4:00 PM	Coffee Break	Ballroom West
4:00–5:45 PM	Simultaneous Panel Presentations II (3 concurrent sessions)	
	4. Best practices in science policy from other nations *Alex T. Bielak, Margaret Dalziel, Tony McBride, Valerie La Traverse, Brian Wixted, Sun Yongjian, Moderator: Paul Dufour*	Ballroom East
	5. Private sector research and development: Role of R&D in the global economy *Eric Archambault, Peter Frise, Phil Schwab, Brian Underdown, Moderator: Rachel Woen Tjoen Soen*	Terrace East/West
	6. The next generation of scientists: Science education and a new culture of civic engagement *David Castle, Sunny Marche, David Rose, Moderator: Bonnie Schmidt*	Ballroom Centre
5:45–6:45 PM	Wine & Cheese Reception; Exhibits	Ballroom West
7:00 PM	Optional Networking Dine-Around Themes: Scientific associations and science advocacy efforts; Science and media, science writers and journalists; A research institute on science policy ***Sign up sheets are available at the Registration Desk***	Various

Friday, October 30, 2009 – 89 Chestnut Conference Centre		
Time	**Event**	**Location**
8:00-9:00 AM	Continental Breakfast & Exhibits	Ballroom West
9:00-9:45 AM	Plenary Session Keynote Address: Hon Gary Goodyear, Minister of State (Science and Technology)	Ballroom East/Centre
9:45–10:00 AM	Break	
10:00–11:45 AM	Simultaneous Panel Discussions III (3 concurrent sessions)	
	7. Meeting the challenges ahead: Canada's policies on environment and energy *Hadi Dowlatabadi, Andrew Miall, Geoff Munro, Randall Goodfellow, Moderator: Julia Deans*	Ballroom East
	8. Who speaks for science? Stakeholder communication in the Canadian scientific community *Deb deBruijn, Rees Kassen, Robert Mann, Reinhart Reithmeier, Moderator: Kevin Shortt*	Ballroom Centre
	9. Science journalism, media and communication *Chantal Barriault, Peter Calamai, Mark Henderson, Nicola Jones, Moderator: Paul Wells*	Terrace East/West
11:45–1:00 PM	Networking Lunch Exhibits	Ballroom East/Centre/ West
1:00–2:45 PM	Simultaneous Panel Discussions IV (2 concurrent sessions)	
	10. Science diplomacy and international cooperation *Paul Dufour, Alidad Mafinezam, Halla Thorsteinsdottir, Caroline Wagner, Monali Ray, Moderator: Kevin Fitzgibbons*	Ballroom East
	11. Innovation commercialization: From bench to market *Tom Brzustowski, Ronald Dyck, Jorge Niosi, Mark Romoff, John Molloy, Moderator: Jeremy Grushcow*	Ballroom Centre
2:45–3:00 PM	Coffee Break	Ballroom West
3:00–4:00 PM	Closing Plenary: Next Steps *Shiva Amiri, Jeff Anders, Paul Ledwell, Masoud Yeganegi, Moderator: Mehrdad Hariri* Conference Conclusion	Ballroom East/Centre