As our fundamental understanding of the physical world has evolved over the course of the last several centuries, so too has our ability to manipulate matter. We can create an extraordinary variety of materials and finished products, many of which have improved our quality of life. The ability to manipulate matter at the most minute scale — the nanoscale, roughly defined as between one and one hundred billionth of a metre — has brought with it the ability to create new classes of materials. These materials, known generically as nanomaterials, have unusual, unexpected properties that are potentially very useful, with applications ranging from new pharmaceuticals to environmental remediation to sports equipment. At the same time, they present concerns arising from potential hazards to human health and the environment that are not well understood.

In July the Council of Canadian Academies published the final report of the Expert Panel on Nanotechnology. The report, entitled Small is Different: A Science Perspective on the Regulatory Challenges of the Nanoscale, was in response to a question posed by Health Canada (and a number of other federal agencies) to examine the state of knowledge with respect to existing nanomaterial properties, their health and environmental risks and how these risks might be managed given current uncertainties and gaps in knowledge.

The 13-member expert panel was appointed by the Council of Canadian Academies and was chaired by Dr. John Grace, Canada Research Chair in Clean Energy Resources and Professor at the University of British Columbia. The panel prepared its report in response to a question posed by Natural Resources Canada:

What are the challenges for an acceptable operational extraction of gas hydrates in Canada?

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Continued on page 3 — “Council Publishes...”
What are gas hydrates?
Natural gas hydrates form under conditions of high pressure and low temperature, when water combines with natural gas (largely methane) to form an ice-like solid substance in regions of permafrost and in subsea floor sediments on continental margins. Although scientists have known about gas hydrates for almost 200 years, the oil and gas industry only began to take an interest in the 1930s when gas hydrate formation in pipelines was found to cause troublesome blockages.

Complex issues would need to be addressed if gas hydrate were to become a significant part of the energy future of Canada and the world — issues that arise from unknowns about the resource itself. How much is there? Where is it located, at what kinds of concentrations, and in what kind of geological environments?

How much gas hydrate is there?
Gas hydrates exist in abundance worldwide. Although the global amount of gas hydrate is uncertain, some estimates suggest that the total amount of natural gas bound in hydrate form may exceed all conventional gas resources, or even the amount of all hydrocarbon energy — coal, oil and natural gas combined. While Canada has some of the world’s most favourable conditions for the occurrence of gas hydrate on its continental margins and under Arctic permafrost, there is a need for further research to better delineate and quantify the resource.

Can gas hydrate be commercially exploited?
While a great deal of exploration and research is taking place worldwide, there is, to date, no commercial production of natural gas from gas hydrate. Although long-term production experience is needed to better understand the potential problems associated with producing gas from gas hydrate, these issues are not expected to be technically insurmountable. Further research and development of efficient means to extract the gas component, in addition to many of the same unpredictable market factors that will govern the future profitability of conventional natural gas, will affect the profitability of gas production from gas hydrate.

Most of the environmental, safety, regulatory and social considerations related to gas hydrate exploitation appear to be similar to those associated with conventional gas production in frontier areas. There are concerns that, once produced, gas from gas hydrate would lead to the emission of carbon dioxide (a greenhouse gas), potentially accelerating climate change. However, when used as fuel, gas from gas hydrate would actually produce less CO₂ per unit of energy than coal or oil.

The panel released a summary document, the Report in Focus: Energy from Gas Hydrates: Assessing the Opportunities & Challenges for Canada, at the 6th International Conference on Gas Hydrates in Vancouver, B.C. on July 7, 2008. The Report in Focus is available online in both official languages at www.scienceadvice.ca. The full report is expected to be released to the public in the coming weeks. To receive hard copies of the report once it becomes available, please contact Samantha Rae, Communications Manager, at 613-567-5000 ext. 256 or at samantha.rae@scienceadvice.ca.

The Council would like to thank the Expert Panel on Gas Hydrates for its hard work and dedication throughout the assessment process. Special thanks are also due to the report reviewers, the report review monitor and a wide variety of contributors who made the report possible.

Some Key Messages
- Natural gas hydrate is a potentially vast, yet untapped, global energy source.
- Canada appears to have some of the world’s most favourable conditions for the occurrence of gas hydrate and is well-positioned to be a global leader in exploration, R&D, and exploitation of gas hydrate.
- Gas hydrate yields natural gas. Most of the environmental, safety, regulatory and social considerations related to its exploitation appear to be similar to those associated with conventional gas production in frontier areas.
- No insuperable technical problems are foreseen in producing gas from gas hydrate, though this would be more costly than producing gas from conventional reservoirs in similar environments.
- Although combustion of gas from gas hydrate would generate less CO₂ per unit energy than either coal or oil, the proportion of gas hydrate, and other hydrocarbons, in the future energy mix will depend on decisions on how best to mitigate the anthropogenic drivers of climate change.
The panel, chaired by Pekka Sinervo, Professor of Physics at the University of Toronto, concluded that too little is known to assess the overall human and environmental risks posed by the introduction of nanomaterials and nanoproducts into society. The panel did not, however, identify any evidence to suggest that nanoproducts currently on the market in Canada present risks that cannot be addressed through available risk management strategies.

What are nanomaterials?
Nanomaterials may be defined as materials having one or more dimensions on the nanoscale — i.e., between 1 and 100 nanometres (nm). A nanometre is one millionth of a millimetre — approximately 100,000 times smaller than the diameter of a human hair. A red blood cell is approximately 7,000 nm in diameter.

As the particle size of certain materials is reduced to the nanoscale, they can exhibit novel and useful properties. Gold, for example, in its bulk form, is inert and resistant to oxidation, but nanoscale gold exhibits a remarkable ability to oxidize carbon monoxide — making it a novel candidate for use in car exhaust systems. A second example — titanium dioxide particles, well above the nanoscale, are responsible for the intense whiteness of many paints and toothpastes whereas the addition of nanoscale titanium dioxide to sunscreens results in their translucence once they are applied to the skin. This difference between nanomaterial properties and their bulk properties is what can make nanomaterials very useful, but these often surprising differences may also result in unanticipated behaviours in biological and environmental systems.

As of April 2008, there were over 600 nanotechnology-based consumer products including: sunscreens, anti-stain coatings on fabrics, antimicrobial features in washing machines and refrigerators various medical and electronic applications, among others.

The sheer diversity of possible nanomaterials, when combined with their unpredictable biological and environmental properties, makes it very challenging to assess the risks of nanomaterials and thus to design regulation to help manage possible risks. The report concluded that to date, there has been no identification of unique biological effects associated with exposure to nanomaterials, but there is still a poor understanding of the pathways by which these effects may occur.

The Canadian Regulatory Approach
The current risk assessment strategies that are used in health and environmental regulations in Canada comprise four steps: hazard identification, hazard characterization, exposure assessment and risk characterization. The application of these to nanomaterials will require new ways for measuring exposure, dose and response. The report concludes that there are, at present, inadequate data to inform quantitative risk assessments on nanomaterials. At most, only qualitative risk assessments are feasible. Moreover, changes in the potential for nanomaterials to cause harm at different stages — from production, through usage, to final disposal — implies the need for a full, life-cycle approach to risk assessment.

Uncertainties associated with risk assessment and risk management are typical in the introduction of new technologies and are not unique to nanomaterials. Such uncertainties have been managed within Canadian regulatory systems by taking a precautionary approach — giving priority to ensuring the safety of health and the environment. Since it is not possible, at present, to implement a robust and reliable “science-based” regulatory approach to nanoproducts, it is important that appropriate precautionary measures guide the scientific assessment of the risks and the selection of standards of safety.

Continued on page 4 — “The Report...”
The Report
The full report and accompanying summary document, the Report in Focus are available for download on the Council’s website, www.scienceadvice.ca. For hard copies of the report, please contact Samantha Rae, Manager, Communications at 613-567-5000 ext. 256 or at samantha.rae@scienceadvice.ca.

The Council would like to thank the Expert Panel on Nanotechnology for its hard work and dedication throughout the assessment process. Special thanks are also due to the report reviewers, the report review monitor and a wide variety of contributors who made the report possible.

Some Key Messages from the Report
• The diversity of possible nanomaterials is vast and the tolerances of a biological/environmental system to changes in the physicochemical properties of nanomaterials that determine their behaviour are poorly understood.
• The current metrological capacity for identifying and monitoring nanomaterials is insufficient to ensure the surveillance of their effects on consumers, workers and the environment. This is further limited by the inability to ensure adequate identification of existing and future nanomaterials and products containing them.
• Systematically targeted research is needed to fill the knowledge gaps and reduce uncertainty.
• The safe introduction of nanomaterials into trade and commerce will require a targeted research approach to both risk assessment and risk management. Additional human and monetary investments will be required to respond to the increasing knowledge and management demands being posed by nanotechnology.
• Prevailing human and ecological risk assessment frameworks are robust, but their application to nanomaterials requires new ways of measuring exposure, dose and response.
• At present, it is not possible to implement a robust and reliable “science-based” regulatory approach to nanoproducts. In this situation it is important to ensure that the appropriate precautionary measures guide the scientific assessment of risk and the selection of standards of safety.

C A N A D I A N  A R C T I C  R E S E A R C H  I N I T I A T I V E  ( C A R I ) :
T H E  T I P  O F  T H E  I C E B E R G

Research in the Canadian Arctic is the subject of the latest project of the Council of Canadian Academies. The Council brought together a multi-disciplinary, international expert panel to discuss the science priorities proposed for a Canadian Arctic Research Initiative (CARI).

CARI will be a signature deliverable of Canada’s Northern Strategy. The Government committed in the October 2007 Speech from the Throne to building an arctic research station “on the cutting-edge of arctic issues, including environmental science and resource development”.

To develop CARI, the government consulted with various Canadian stakeholders to create a Visioning Workshop report, “Defining Science Priorities for Canada’s New Arctic Science Station”.

The Council of Canadian Academies was subsequently commissioned by the Department of Indian and Northern Affairs (INAC) to assemble an expert panel to validate the priorities in the Visioning Workshop report, consider Canada’s principal Arctic science “advantages”, advise on the approach to designing CARI, and reflect on what measures will ensure its success.

The 13-member panel was chaired by Elizabeth Dowdeswell, Chair of the Council’s Scientific Advisory Committee who is also Former UN Under-Secretary General and Executive Director of UNEP, and Founding President and CEO of the Nuclear Waste Management Organization.

The panel met at the House of Estates of the Prime Minister’s Office in Helsinki, Finland on July 24 and 25. The meeting was hosted by Professor Matti Saarnisto, Secretary General of the Finnish Academy of Science and Letters.

The panel’s report is expected to be made public the second half of October 2008.

Continued on next page — “The Expert Panel...”
In March 2007, the Government of Canada announced it would provide the Social Sciences and Humanities Research Council (SSHRC) $11 million annually to support additional research in management, business and finance. In their efforts to design an effective long term strategy for the financial allocation, SSHRC has commissioned the Council to provide an independent review of the strengths and weaknesses of current research in Canada in the areas of management, business and finance. Specifically, the Council was tasked with answering the following question:

- What are the overall, identifiable, strengths and weaknesses of the university-based research community in the areas of management, business and finance, broadly defined, according to appropriate indicators?

To answer this question, the Council has assembled an expert panel, chaired by Dr. David Zussman, who currently holds the Jarislowsky Chair in Public Sector Management in the Faculty of Social Sciences and the Telfer School of Management at the University of Ottawa. The full panel has already met three times in person and is scheduled to meet again at the end of October.

To conduct its assessment, the panel will use a variety of methods including one-on-one interviews with stakeholders and a public call for submissions (for more information see: www.scienceadvice.ca).

Continued on next page — “The Expert Panel...”
**The Expert Panel on Management, Business and Finance in Canada**

David Zussman (Chair)
Commissioner, Public Service Commission of Canada and Jarislowsky Chair in Public Sector Management in the Faculty of Social Sciences and the Telfer School of Management at the University of Ottawa (Ottawa, ON)

Peter Aucoin, C.M., FRSC
Eric Dennis Memorial Professor of Government and Political Science and Professor of Public Administration, Dalhousie University (Halifax, NS)

Robert L. Brooks
Vice Chairman, The Bank of Nova Scotia (Toronto, ON)

Sheila A. Brown
Former President and Vice Chancellor, Mount Saint Vincent University (Halifax, NS)

Fred Gorbet, C.M.
CIT Chair in Financial Services, Associate Director, Financial Services Program, Schulich School of Business, York University (Toronto, ON)

John H. McArthur
Dean Emeritus, Harvard Business School (Wayland, MA)

Randall Morck
Stephen A. Jarislowsky Distinguished Chair in Finance and University Professor, University of Alberta (Edmonton, AB)

Michael Ornstein
Director, Institute for Social Research, York University (Toronto, ON)

Jean Marie Toulouse, FRSC
Professor, Department of Management, HEC Montreal (Montreal, QC)


**Ongoing Assessments**

**Groundwater: Thirsting for Answers**

Poets herald water as the elixir of life. Chemists explain that water is the ideal solvent for a carbon-based ecosystem, establishing the bond between water and life. Economists forecast that fresh water is becoming the primary constraint on growth for many nations and it is expected to be the most important and strategic natural resource of the coming century. Hydrogeologists confirm that about 97 percent of fresh water is buried beneath our feet and engineers acknowledge that groundwater is already our most consumed raw material reflective of an increasing per-capita thirst of a growing global population. How do we manage such a valuable resource in Canada, and are we doing so sustainably?

The Council’s upcoming report on Groundwater Sustainability aims to answer this question. For more information visit the Council’s website at [www.scienceadvice.ca](http://www.scienceadvice.ca).

**Private Sector Innovation: Lagging Behind the Competition**

From imagination to reality, innovation is the manifestation of human potential and creativity. While invention may be seen as the creation of a new idea or product, innovation is the substantial implementation of these related inventions. Innovation allows society to solve problems and seize new opportunities. It allows businesses to thrive because novel products and more efficient processes make businesses more competitive. Innovation also effectively drives our ability to create more economic value from an hour of work, which results in rising wages and incomes, and ultimately leads to a higher standard of living.

But Canadian business is lagging in innovation behind that of the U.S. and other countries. Even though innovation is good for business and increases competitiveness, wages and incomes, Canadian businesses are falling behind. The question is: why?

The Council’s upcoming report on Private Sector Innovation seeks to answer this question and provide a detailed analysis of Canadian innovation, or the lack thereof. For more information, visit [www.scienceadvice.ca](http://www.scienceadvice.ca).
On July 11, 2008, the Honourable Jim Prentice, Minister of Industry, announced the appointment of Mr. Preston Manning, C.C. to the Council’s Board of Governors.

Mr. Manning served as a Member of 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 Canadian 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.

Dr. Danial D. M. Wayner (FRSC), Director General of the Steacie Institute for Molecular Sciences at the National Research Council of Canada was recently appointed by the Royal Society of Canada to the Council’s Board of Governors.

Dr. Wayner received his BSc from McMaster University and his PhD from Dalhousie University. Following the completion of his doctorate he joined the National Research Council of Canada (Division of Chemistry) where he carried out research in physical organic chemistry and surface chemistry, eventually rising to the level of Principal Research Officer. From 2001 and 2003 he served as the founding Director General of the National Institute for Nanotechnology (NINT), an NRC institute built in partnership with the University of Alberta and the Province of Alberta. At NINT, Dan was responsible for building the tripartite partnership, the design of a new building, the development of the Institute’s research focus and the hiring of the first research and support staff. In 2003 he accepted his current position as Director General of the NRC’s Steacie Institute for Molecular Sciences.

Dan Wayner has served on the Editorial Advisory Board of the Journal of the American Chemical Society (the flagship journal of the ACS) and is currently on the Editorial Advisory Board of Surface Science. He has received numerous awards and recognition of his research contributions including the Rutherford Medal (chemistry) of the Royal Society of Canada and a research fellowship from the Japan Society for the Promotion of Science. He is a Fellow of the Royal Society of Canada and of the Chemical Institute of Canada.

Employment Opportunities
The Council is always attracting highly motivated and enthusiastic individuals to join its team of professionals.

Employees of the Council strive to embody the Council’s two principal values — Excellence and Teamwork — and uphold its mission:

To support expert assessment of the science, broadly interpreted, that is relevant to matters of importance for Canadians with the objectives of enhancing public understanding and of informing debate and decision-making.

For information on current and future employment opportunities please visit the Council’s website at www.scienceadvice.ca.

Annual Report 2007-08
The Council of Canadian Academies recently published its Annual Report 2007-08. The document provides a concise breakdown of ongoing and completed assessments and outlines the Council’s goals for 2008-09. To download an electronic version of the document, please visit the Council’s website at www.scienceadvice.ca.

Thank You to Our Summer Students
The Council staff would like to extend a sincere thank you and very warm wishes to the summer students who worked diligently alongside members of the staff over the past few months. Thank you to Michelle Dugas, Joe Rowsell, Jason Sherriff and Amy Usher — your dedication and hard work have been very much appreciated and we would like to wish all of you the very best as you return to school in the fall.

Sincerely,
The Council staff
AROUND THE COUNCIL

The Council of Canadian Academies is pleased to welcome Dr. Kelly VanKoughnet to its staff. Kelly, who joined the Council in May 2008 as Vice President of Corporate Affairs, intends to focus her initial efforts on the recruitment of new talent to the organization, the development of assessment-related policy, corporate management, governance and finance.

Kelly comes to the Council after serving as Acting Vice-President, Research, at the Canadian Institute for Health Research (CIHR) where she aided in the development and implementation of the CIHR vision — “to excel, according to internationally accepted standards of scientific excellence, in the creation of new knowledge and its translation into improved health for Canadians, more effective health services and products and a strengthened Canadian health care system.” During her time at CIHR, she held a number of other key positions including Special Advisor to the President and Director of Research Planning and Resourcing.

Kelly holds a Ph.D. in Neurobiology from Harvard University, a Master’s of Medical Science from Harvard Medical School, and a Bachelor of Science from the University of Toronto. Upon completing her graduate work, and before joining CIHR, Kelly pursued an opportunity with the Office of Science Policy and Planning of the U.S. National Institutes of Health (Bethesda, MD) where she was active in the discussion and development of policy on such issues as stem cells and privacy regulations for health information.

The Council would like to recognize the wealth of knowledge and experience that Kelly brings to the team and looks forward to benefiting from her leadership and expertise.

It is with mixed emotions that the Council of Canadian Academies announces the departure of Ms. Katherine Levitt from its staff. Katherine leaves the Council to pursue a degree in Law at the University of Ottawa.

Katherine, who began working with the Council in March 2006, served as one of the first Program Directors on staff and was a driving force in the production and publication of the Council’s inaugural report, The State of Science and Technology in Canada. During the early days of the Council, Katherine readily took on a number of different roles making invaluable contributions in the areas of governance, policy, administration and human resources. More recently, Katherine served as the lead Program Director for the assessment on the Sustainable Management of Groundwater in Canada and assisted in the development of the assessment on Gas Hydrates.

The Council would like to recognize Katherine’s willingness to take on new challenges and her drive to go above and beyond. Though she will be missed, the Council staff wish Katherine the very best in her future endeavours and thank her for her tremendous contribution to the Council’s formative period.

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