GE³LS

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Ensuring leadership in ethical, environmental, economic, legal and social issues related to genomics

Canada partners with EU

Cross-Border Research: Canada joins forces with EU to shape transnational GE³LS research agenda

Canada is the only non-European nation, besides Israel, to be invited to help shape the future of transnational research into the societal aspects of genomics. The European initiative could pave the way for Canadian researchers to collaborate in global research consortiums.

> "At the European level, research into the societal aspects of genomics is not only small in scale, but also badly fragmented – both between countries and between scientific disciplines."

The European Research Area for Societal Aspects of Genomics, "ERA-SAGE" for short, brings Canada to the table with partners from eleven national funding agencies in nine countries, including the United Kingdom, Austria, Norway, Finland, Germany, the Netherlands, Switzerland and Israel. In Canada, the partnership has been led by the Social Sciences and Humanities Research Council (SSHRC), with input from the Canadian Institutes for Health Research (CIHR) and Genome Canada.

Launched to help individual funding agencies make a bigger impact, ERA-SAGE aims to increase coordination and cooperation among research programs and pool fragmented resources, both human and financial.

"At the European level, research into the societal aspects of genomics is not only small in scale, but also badly fragmented – both between countries and between scientific disciplines," according to *Networking the European Research Area*, a European Commission publication.

ERA-SAGE is funded by the European Research Area Network (ERA-NET), a scheme for stepping up the cooperation and coordination of research activities carried out at the national or regional level in EU member states and associated states. It's a component of the European Commission's €19.2 billion Sixth Research Framework Programme.

"With often too little national funding at their disposal to make as large an impact as they would like in these critical sectors, [funding agency] managers are, nonetheless, frustrated to see the research that they fund nationally not to have the right critical mass or being duplicated in other countries," notes Commission publication, *Networking of national research programmes in the European Research Area.*

"ERA-NET helps position Europe strongly on innovation, helping them to compete with Japan and the US," notes **Christian Sylvain**, Director, Policy, Planning and International Affairs with SSHRC. "Interest from the Brussels perspective is not to intervene in national research agendas, but to ensure that the agencies that fund these national research agendas talk to one another and coordinate, on their own terms, the research on a European scale."

Involvement in ERA-SAGE a "great nod in Canada's direction"

As the only ERA-NET initiative of about 80 to have a full non-European member, Sylvain acknowledges that Canada's involvement in ERA-SAGE is "a bit of an anomaly, but a great nod in Canada's direction".

Canada's participation evolved from being included as a benchmark country for an initial GE³LS research mapping exercise, led by the Centre for Society and Genomics in Nijmegen, Netherlands. According to Sylvain, that benchmarking project, called "Network Observatory for Research on Societal Aspects of Genomics", or "NORSAGE" for short, put Canada's **(con't pg. 2)**

ERA-SAGE Workshop I: Research Trends in Canada and the US

GE³LS research in Canada and the US tends to "lag behind" scientific research, creating a "barrier" to researching the societal aspects of genomics, according to the first part of a Canadian submission to an international consortium of research agencies.

The study was funded by the ERA-SAGE network, a consortium of eleven agencies in nine countries aiming to develop partnerships in policy and practice and a transnational research agenda on the ethical, environmental, economic, legal and social aspects of genomics. The five-year program of collaboration and action has been broken down into five stages or "work packages".

Representing the first part of "Work package 2", the submission formed the basis for discussion at ERA-SAGE Workshop I, held in Ottawa in May 2006. It lists a compendium of GE³LS research projects publicly funded in Canada and the United States in 2005–2006 and identifies emerging issues related to human genetics and genomics.

"The integration component was often seen as a barrier to the research process," notes *Review of Research in Canada and the United States and Synthesis of Key Informants' Views,* co-written by Dr. **Denise Avard** *et al.* "Many respondents noted problems with 'downstream' research since GE³LS research seems always to lag behind scientific research."

The study also ear-marked several concerns requiring more exploration, including: the convergence of technologies with genetics and genomics; nanotechnologies and biotechnologies; the social implications of genetic testing as a preventive measure for public health; the storing of genetic materials in biobanks; and the abuse of genetic information by health professionals, insurers and employers.

"…the convergence of genomics with biotechnologies, nanotechnologies and bioinformatics … create new challenges and may require a re-conceptualization of approaches to regulation and technology assessment," the study found.

Private funding sources were also identified as a main "source of tension", raising questions about conflict of interest, commercialization, and the inappropriate regulation of the private sector. The study also noted the importance of stand-alone projects, which "allow the development of sensitive studies" and "can address issues that are too threatening within science projects."

"All these issues will take time to come together and will require a nurturing research environment," states the study. "Future research will depend on whether the pool of researchers working on GE³LS issues can be expanded to include individuals from a broader range of humanities and social science disciplines." ❖

INside

GE³LS Websites to watch

Genome Canada: www.genomecanada.ca
Genome British Columbia: www.genomebc.ca/ethics
Genome Alberta: www.ge3lsalberta.ca
Genome Prairie: www.genomeprairie.ca
Ontario Genomics Institute: www.ontariogenomics.ca
Genome Quebec: www.genomequebec.com

GenomeCanada · OntarioGenomicsInstitute · GenomeQuébec · GenomeAtlantic · GenomeBritishColumbia · GenomeAlberta · GenomePrairie

Canada partners with EU (con't)

GE³LS research on the European Commission's radar screen.

"We came up so strongly in that study that when it came down to applying for funding, Brussels had been sensitized to Canada's world-class work in GE³LS, and they knew SSHRC," says Sylvain, who was involved in the initial mapping exercise and spent considerable time touting Canada's expertise in GE³LS research. "On that basis, they decided to fund Canada's participation in the network as a full partner. It's a bit of an experiment by Brussels to bring in a non-European partner."

"The Europeans are mounting something big, something that could lead to the European Commission investing a lot of money into GE³LS research," adds Sylvain. "They're going to do it on the basis of the strategic plan that emanates from ERA-SAGE. We're there at the board table and we're influencing the strategic process so that, tomorrow, if international research activity is funded by the Commission or by all of these nations independently, we will be comfortable with the nature of that program of research because we'll have had a hand in shaping it. And therefore our research community can be active in it."

Ultimately, ERA-SAGE will also enable national research programs to take on tasks collectively that they would not have been able to tackle independently. As Sylvain points out, "A great side benefit of this project is that it has brought SSHRC, Genome Canada and CIHR closer on these issues."

"The future of social sciences and humanities research is based on international collaboration," says Sylvain. "The issues and problems that our research community grapples with cannot easily be addressed without working with others." ❖

ERA-SAGE Workshop II: Best Practices in Research Funding

Recommendations to contribute to ERA-SAGE strategic plan

Recommendations from the second ERA-SAGE workshop, held in Ottawa in November 2006, are expected to contribute to the development of the ERA-SAGE strategic plan, to be released in autumn 2007.

The workshop, which represents the second part of ERA-SAGE "Work package 2", focused on identifying elements of best practices and future directions in GE³LS research funding. Discussions centered around four major themes: funding strategies; quality management; capacity, specialization and diversity; and GE³LS and genomic science.

Organized jointly by Genome Canada, CIHR and SSHRC, the workshop brought together scholars and research administrators from academia funding agencies, government departments, non-governmental organizations and the private sector. Funding agency managers also reviewed the inventory of GE³LS funding programs in Canada and considered input from members of the GE³LS research community and the Canadian public, who contributed their thoughts through a formal "request for input" prior to the workshop.

SSHRC, CIHR and Genome Canada indicated they will consider ideas put forward at the workshop in future development of their respective programs. ❖

For more information on the ERA-SAGE initiative and workshops, or to obtain a copy of submissions and related documents, see ***http://www.genomecanada.ca/erasage/documents.asp.***

The five-year ERA-SAGE program of collaboration and action has been broken down into five stages or "work packages". While Canada is involved at every stage, the country is taking a leading role in Work package 2.

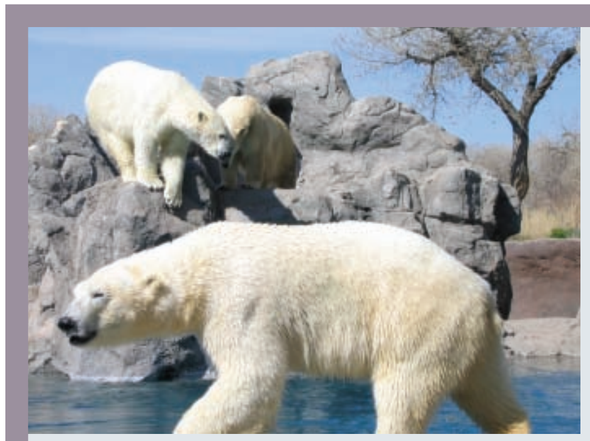
Work package 1: Synergy Building – Producing a broad overview of programs and policies in member countries.

Work package 2: Needs Assessment – Understanding, through detailed "mapping," research trends and best practices in research funding.

Work package 3: Capacity Building – Developing common standards for evaluation and common grounds for program development and management.

Work package 4: Human Resource Management and Mobility – Improving co-ordination and mobility and to develop a shared training agenda.

Work package 5: Research Building – Developing and implementing transnational programs and research activities.



New Field of *"Metagenomics"* Could Yield Climate Change Clues

Canada shouldn't wait to embark on new science, warns Canada Research Chair

Bacteria do not operate in isolation, but genomic scientists have tended to study them that way, according to Dr. **Ford Doolittle**, a professor in the Department of Biochemistry and Molecular Biology at Dalhousie University and Canada Research Chair in comparative microbial genomics.

However, a recent shift in experimental methods – called "metagenomics" – is allowing scientists to sample larger communities of microbes within a specific environment and is spawning new methods of computational analysis to make sense of the data. And it's giving scientists a new tool for understanding biological diversity and monitoring the environment.

In his presentation at the recent International Genomics Conference in Quebec City, entitled "Metagenomics will be to Genomics what Genomics has been to Genetics", Doolittle described the relatively new field of study, which is essentially genomics on a 'community' scale. Instead of studying single genomes from bacteria cultured in the lab, metagenomic scientists study genes recovered from environmental samples, such as soil or water.

Dr. Ford Doolittle

"We're starting to recognize that if we want to get useful biological information from genome sequences, we have to sequence all the DNA we can find in a particular environment, instead of culturing a particular strain," said Doolittle in a subsequent telephone interview.

Most microbes are resistant to cultivation and exist in the environment as part of 'communities' of multispecies bacteria, making them harder to isolate and characterize.

"Only one percent of bacteria can be cultured," said Doolittle, who is also director of the Program in Evolutionary Biology of the Canadian Institute of Advanced Research, "and they tend to be what we call 'lab weeds' – bacteria that can grow easily in a lab. Traditional microbial genomics methods neglect organisms that require for their growth the presence of other organisms, because you're supposed to work with pure cultures."

Even those microbes that can be cultured in isolation are highly variable and diverse. "About 1000 different microbial species have had their genomes sequenced," he adds. "If you sequence one strain, say a lab strain of E coli, and compare it to the strain from Walkerton*, they differ by about 30 percent in terms of the genes they have. That's more of a difference in novel gene content than you find between all the animals."

The new science is not only uncovering a dizzying variability within microbial genome sequences, it's also blurring the line between species, making the term 'bacterial species' essentially meaningless.

"Bacteria pass genes back and forth across species lines quite promiscuously," says Doolittle, referring to the phenomena known as 'lateral gene transfer'. "'Bacterial species' is in fact a very loose term describing a collection of organisms that have some similarities."

Because metagenomic data can be used to obtain a profile of the microbial community residing in a particular environment, it can help scientists understand the services microbes perform in the biosphere and the roles they play in the maintenance of human health, without the need to focus on or even define the genome of any single species.

"It's an exquisite way to monitor the environment in terms of what's happening at the biochemical level. It's exquisitely relevant to climate change."

While some detractors argue that metagenomics is expensive and mindless data gathering, lacking scientific hypotheses, Doolittle points out that "those were exactly the same arguments leveled against the development of genomics in the first place."

Doolittle, who currently sits on a panel of the US National Academy of Sciences that is advising the Department of Energy and National Sciences Foundation as they formulate plans for metagenomics research, warns that Canada risks being left behind.

"Canada has a habit of being late off the mark in various innovative areas of science. We should not be late on this one too." ❖

**Ed. Note: E coli bacteria from farm runoff contaminated the water supply in Walkerton, Ont., in May 2000, resulting in seven deaths.*

Reports below and pg.2 from Genome Canada's International Genomics Conference:

2020 Vision: Variation and Function in the Genome
held October 25th to 27th in Québec City

"Move Slowly" in March toward Personalized Medicine

Discovery of type-2 diabetes gene variant only a "small piece of the puzzle"

Discovering a link between a gene variant and a common disease is widely considered a 'eureka step' in the evolution of personalized medicine. But disclosing a predisposition to a disease, sometimes decades ahead of its threatened onset, could trigger fatalism instead of motivating people to make dietary and lifestyle changes.

"I find it bemusing," says Dr. **Wylie Burke**, chair of the Department of Medical History and Ethics at the University of Washington who spoke at Genome Canada's International Genomics Conference held in Quebec City last October. "The natural impulse is to want to disclose genetic information right away, to think that people will be empowered by knowing they carry a certain genetic variant and might be at a greater risk for developing a certain disease. But that impulse flies in the face of the kind of thoughtful, careful and orderly approach we need to take before we simply disclose the information to someone."

Burke focused on the recent discovery of the TCF7L2 gene variant, associated with a greater risk for developing type-2 (adult-onset) diabetes. About a third of the population carries the genetic variant, thought to increase their lifetime risk of developing the disease by 50 percent – from about 5 to 10 percent to between 7.5 and 15 percent. About a tenth of the population carries two copies of the variant, thought to double their lifetime risk to about 10 to 20 percent.

Iceland-based deCode, a company that specializes in studying Iceland's DNA database, made the discovery. Virtually the entire population of Iceland, a highly homogeneous group, has voluntarily donated DNA to be sequenced, analyzed and published. The deCode team first identified the gene in Icelanders with diabetes, and then studied 228 Danish women with type-2 diabetes and 539 who did not have the condition. They also studied 361 American diabetics of European descent and 530 similar people without diabetes.

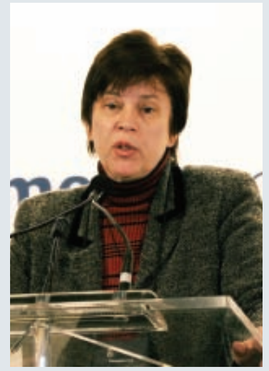
Burke, who has a PhD in genetics and an MD from the University of Washington, believes that while it's tempting to immediately begin testing people for the TCF7L2 gene variant, medical experts should "move slowly".

"One of the things we've concluded is that it's extremely important not to think about genetic tests generically", she says, citing tests for genetic disorders such as Duchenne Muscular Dystrophy, a degenerative disease primarily affecting voluntary muscles, and PKU, a disorder characterized by the body's inability to use the essential amino acid phenylalanine, which can cause significant brain problems.

"We have tests for gene deletions in Duchenne Muscular Dystrophy, for example, which enable us to diagnose kids with certain kinds of clinical problems. That test is very helpful in giving a firm diagnosis and allowing families to understand and manage the disease. In the case of PKU, we know we can provide dietary counseling and supplements that will tremendously change a child's life."

By contrast, the type-2 gene variant has a far lower predictive value. "There's still a greater chance not to get the disease than to get it," says Burke.

Along with the potential for psychological stigmatizing, testing positive for the variant could also lead to insurance discrimination and a sense of fatalism. Studies have shown that when people are presented with genetic information about a predisposition to a disease, they may become defeatist. "Their reaction may be, 'Then I can't change it'," says Burke, who notes that this issue remains "understudied."



Dr. Wylie Burke

But a negative test result could also lead to discrimination. "Those people who don't test positive for the gene variant may remain at risk due to other genetic or environmental factors, such as diet and lifestyle," says Burke. "Where would a negative test leave them?"

Burke can imagine ways to overcome these obstacles and speculates that such tests could one day contribute to personalized medicine, perhaps by being part of a panel of tests to identify a variety of risk factors for which established interventions are available. They could also be the trigger for extra follow-up counseling, dietary advice and drug therapies. However, she notes that discovering a genetic variant is just the beginning and "we ought to go down this path pretty cautiously."

"Once we have a genetic test, we have to ask a series of questions before we make it available," says Burke. "Who should have it? Is it even ready for clinical prime time? How do we make sure that it's used appropriately, that it gets to the right people, that people interpret the results appropriately, and that they take the proper actions afterwards? We do know, for example, that PKU screening is useless unless you follow-up with the proper diet, and follow-up can vary dramatically from state to state."

"We need to acknowledge the appeal of gene discovery, but move beyond the idea that it automatically brings benefit to actual proof that we can do some good. The genetic piece is a small piece of the puzzle." ❖

Personalized Medicine

Personalized medicine is the use of detailed information about a patient's genotype or level of gene expression and a patient's clinical data in order to select a medication, therapy or preventative measure that is particularly suited to that patient at the time of administration.

The key task is to find genes and gene variations that play a role in a disease. The first step is to associate the occurrence of a particular gene variant with the incidence of a particular disease or disease predisposition – an association that can vary from one individual to another depending on many factors, including environmental circumstances. The outcome is the development of biomarkers which are stable and predictive.

Source:
http://en.wikipedia.org/wiki/Personalized_medicine

"Organo-Transgenic" Crops: Should Organic Farming Include Transgenic Crops?

"There are no major reasons why organic farming strategies should exclude transgenic crops, except of course marketing reasons built on a totally misguided public perception in particular regions", says a noted plant scientist who spoke at the International Genomics Conference held in Quebec City last fall.

In his talk, Dr. **Klaus Ammann**, who also specializes in ecological risk assessment, argued that organic farming is "now growing rapidly out of the corner of backward thinking Luddites, becoming a veritable industry".

"Up to now it is unfortunately an important part of an organic farming marketing strategy to exclude GMOs strictly, also its byproducts," notes the University of Delft Professor and former Director of its Botanical Garden, in an unpublished paper. "…we think it would be wise to open the toolbox of breeding to the most modern methods: Although marker gene assisted breeding is accepted by many organic farmers, genetic engineering is excluded by almost everybody in this [organic farming] scene…"

According to Ammann, a closer look at molecular processes indicates that nature and molecular engineering follow similar tactics. Natural mutation, he argues, follows the same three strategies as genetic engineering: DNA acquisition through horizontal gene transfer, DNA rearrangement through recombinational reshuffling of genomic DNA sequences, and local change of DNA sequences through internal and environmental mutagens and replication infidelities.

He also notes that in classic breeding, manipulative techniques have become "routine", including manipulating chromosome numbers, handling fragments of chromosomes, inverting and transposing sections of DNA, and triggering mutations for breeding purposes using gamma radiation and toxic substances.

"While certainly less targeted and elegant than genetic engineering, such manipulative techniques are, nevertheless, being used," says Ammann.

"The arguments against GMOs in organic farming are not very convincing, since they do not really show the whole picture of what happens in traditional breeding on a molecular level – establish the concept of 'intrinsic naturalness of the genome' – but this is pure fiction, since most crops have a thoroughly artificial structure of the genome, and … lots of traits of well known cultivars have gone through indiscriminate gamma radiation."

"It is time to forget about ideological warfare," he states, "since the biotech crop industry has also learned how to deal with environmental problems. Indeed, there has been dramatic progress in this area." ❖

Dr. Klaus Ammann

For a program and complete list of speakers, see http://www.genomecanada.ca/conference/program.pdf.

Genome Canada Takes First Steps toward Promoting GE³LS Agenda across Canada

New GE³LS Consultant hired to help promote GE³LS agenda and broaden the GE³LS community across Canada

Profile: Dr. Vardit Ravitsky

As someone who routinely navigates the often 'grey' areas of bioethics, Dr. **Vardit Ravitsky** is clear about one thing: she'd like to dismantle the concept of the "ethics police."

"Many scientists are genuinely open and really want to collaborate," says Ravitsky, who began in the new position of GE³LS Consultant at Genome Canada in April 2006, "but others still think of ethicists as the 'ethics police'. We're called in when a problem arises or there's a potential liability issue. It's the wrong metaphor."

Consulting with ethicists after-the-fact can be the "worst way" to deal with ethical quandaries that arise during genomics research, says Ravitsky, who investigated the problem of different research findings – for example, the unexpected discovery of gene mutations in epidemiologic studies – during a two-year post-doctoral fellowship with the Bethesda, Maryland-based National Institutes of Health (NIH) from 2003 to 2005. Her proposed approach – which encourages scientists to anticipate challenging situations and integrate plans for disclosing unexpected findings to research participants – was recently published in *The American Journal of Bioethics*.

The prospect of collaborating with scientists and addressing GE³LS-related issues upfront, rather than after-the-fact, was a big part of what drew Ravitsky to the new position of GE³LS Consultant at Genome Canada.

Dr. Vardit Ravitsky

Ravitsky, who divides her time between Ottawa and Philadelphia, where she teaches in the University of Pennsylvania's Department of Medical Ethics ("I spend a lot of time on planes," she admits), was also drawn to the position due to Canada's reputation for GE³LS research. She believes that Canada is "leading the way" in funding large-scale GE³LS projects and widening the focus beyond ethical, legal and social issues to include economic and environmental considerations. Canadian genomics projects on fisheries, forestry and agriculture are also triggering unique questions.

"The GE³LS community in Canada is expanding – fast. The areas of research are also expanding. And Canada is on the international map when it comes to what it's producing," says Ravitsky, who often assigns journal articles by Canadian academics to her students because they're "the highest quality on certain topics in GE³LS."

> "The GE³LS community in Canada is expanding – fast. The areas of research are also expanding. And Canada is on the international map when it comes to what it's producing," says Ravitsky.

"It was a very bold move for Genome Canada to require that GE³LS be integrated with genomics research," says Ravitsky, "It's a new model, so there are growing pains, but it's provoking new and very interesting questions."

Ravitsky's overall mandate is to help promote the GE³LS agenda and help broaden the GE³LS community across Canada and internationally. She is Genome Canada's representative to a resource-sharing network with members from each of the six regional Genome Centres. Her portfolio of activities is closely tied to the recommendations arising from the Ottawa GE³LS Workshop on Genome Canada GE³LS initiatives, held in February 2006 (see below). So far, plans include helping to create a National GE³LS Strategic Framework, help organize GE³LS conferences and workshops, and facilitate further integration of GE³LS within the annual Genome Canada science symposium.

"One of the challenges we're still struggling with is defining GE³LS within the sciences. Many scientists don't realize that GE³LS is made up of numerous subdisciplines, each of which can make a unique contribution at the project level."

Ravitsky has also taken the lead in coordinating Genome Canada's contribution to the European Research Area initiative on the Societal Aspects of Genomics (ERA-SAGE) (see related stories on pages 1 and 2). The only country outside the European Union, besides Israel, to be invited to participate in ERA-SAGE, Canada is working with eleven agencies in nine countries to achieve greater synergy and convergence in GE³LS research internationally.

"Genomics technologies and research are expanding into new areas, such as nanotech and stem cell research. We want to expand GE³LS research both within Genome Canada and in the broader community, and even our understanding of what GE³LS is. The idea is to think ahead and look at the big picture – nationally and internationally." ❖

Profile: Vardit Ravitsky, GE³LS Consultant, Genome Canada

Specialization
Applied Ethics, Bioethics (genetics, reproduction, research ethics, end of life, cultural frameworks and public policy).

Past Positions
Postdoctoral Fellow, Department of Clinical Bioethics, NIH and Social and Behavioral Research Branch, NHGRI (National Human Genome Research Institute), 2003-2005.

Researcher, Unit for Health Rights and Ethics, Gertner Institute for Health Policy Research, Israel, 2001-2003.

Education
Ph.D., Philosophy, Bar-Ilan University, Israel, 2004 (Dissertation: Genetic Intervention and the Shaping of Human Identity).
M.A., Philosophy (with distinction), University of New Mexico, USA, 1996 (Thesis: The Right to Procreate in the Age of Technologically Assisted Reproduction).
B.A., Philosophy (with honors), Sorbonne University, France, 1991.

Creating a GE³LS Culture

Ottawa GE³LS Workshop: "Improve integration of GE³LS into genomics science and create a GE³LS culture"

More needs to be done to bridge traditional divisions between genomics science research and GE³LS research and to build a "GE³LS culture" in Canada, according to a report prepared for Genome Canada on behalf of the GE³LS Workshop Steering Committee.

The report was released last spring after representatives from various stakeholder groups gathered in Ottawa to discuss Genome Canada GE³LS initiatives, both current and future. The meeting was hosted by Genome Canada's Science and Industry Advisory Committee (SIAC) and its Board of Directors. Discussion was also stimulated by responses to a questionnaire sent to members of the broader GE³LS community prior to the meeting.

Workshop participants identified two themes to be addressed by the workshop: *Improving Integration of GE³LS into Genomic Science and Creating a GE³LS Culture.*

"…the GE³LS community has expanded in numbers and diversity of disciplinary backgrounds," states the report. "This 'loose knit' collection of researchers and professionals employs a diversity of methods and modes of analysis with sometimes conflicting goals and objectives. This broadening of the GE³LS community should be viewed against the backdrop of calls from within the community to create a rich and robust GE³LS culture in Canada. Members of this community have also expressed interest in bridging the traditional divisions between genomics science research and GE³LS research to achieve a more integrative interdisciplinary community that encompasses shared learning. Genome Canada and the [six regional] Genome Centres can [play] and are playing an important role in supporting and facilitating the development of a GE³LS culture. This workshop is part of that on-going process."

> "This broadening of the GE³LS community should be viewed against the backdrop of calls from within the community to create a rich and robust GE³LS culture in Canada."

The report summarizes goals identified by questionnaire respondents and workshop participants, and outlines recommendations to Genome Canada's SIAC and its Board of Directors.

To view the full Ottawa GE³LS Workshop Report, which was prepared by two members of the Ottawa GE³LS Workshop Steering Committee, Drs. Sarah Hartley (Genome BC) and Bryn Williams-Jones (Université de Montréal), please contact Genome Canada at 613 751 4460. ❖

Q&A with Dr. Arthur J. Hanson, O.C.

Canada "Too Slow" in Using Biotechnology for Sustainable Development: Report

Dr. Arthur J. Hanson

Biotechnology could help Canada achieve its environmental and economic objectives, but the country is not moving quickly enough, says noted sustainable development advocate in *BioPromise?* report

What will Canada look like in the year 2020?

Will the country, as many are predicting, be facing such environmental calamities as rising sea levels, water and energy shortages and crop failure?

Or will it be possible to find innovate approaches to confront the 'uncomfortable truths' of a growing environmental crisis faced not only by Canadians, but people around the world?

A study released by the Canadian Biotechnology Advisory Committee (CBAC) in October 2006 takes a visionary approach to imagine what Canadian society could look like in 2020 if certain biotechnology innovations were harnessed. The landmark report, entitled *BioPromise? Biotechnology, Sustainable Development and Canada's Future Economy,* identifies key actions and principles needed for biotechnology to contribute to sustainable development objectives – from rural economic development to ecological monitoring to international cooperation.

As with previous studies on health and human genetic material, CBAC convened an independent Expert Working Party (EWP) to perform research and analysis on the wide-ranging topic. At the helm was Dr. **Arthur J. Hanson**, a noted expert in the fields of environmental science and sustainable development and an officer of the Order of Canada.

A long-time advocate for seeking win-win opportunities linking economy with the preservation of natural resources, Hanson was founding director of the School for Resource and Environmental Studies at Dalhousie University. His leadership later brought widespread recognition to the Winnipeg-based International Institute for Sustainable Development, where he is currently distinguished fellow. He is also a member of the Canada Foundation for Innovation, and the China Council for International Cooperation on Environment and Development.

According to Hanson, biotechnologies are already showing promise in reducing pollution from manufacturing, producing crops in less environmentally damaging ways, and extracting useable energy from waste products. Hanson believes that by 2020 biotechnology could be playing a much stronger role.

"Imagine in 2020 a flourishing rural economy that supplies one-quarter of Canada's fuel, chemical and synthetic product needs from renewable biomass sources; a 50 percent reduction in the use of harmful chemicals that accumulate in the environment and in peoples' bodies," says Hanson. "We could do this and more, including putting an end to contaminated industrial sites and involving Canadians in a biowaste-to-bioproducts strategy. If we put strong policy and governance instruments in place, biotechnology could contribute in a major way to these outcomes. It is a tool that – when appropriately deployed – can help Canada achieve its environmental and economic objectives."

Dr. Hanson was contacted via telephone at his home in Victoria, BC.

Why focus on biotechnology and sustainable development?

It links two forms of innovation. Sustainable development is, in its own right, an innovative approach to changing society to take environment into account, in the context of economy and the social wellbeing of people. Biotechnology is one of those innovation technologies whose time appears to have come.

What approach did the Expert Working Party take to tackle such a wide-ranging topic?

In our deliberations, we felt we should take a somewhat novel approach to addressing how biotechnology might help us achieve sustainable development outcomes. We tried to think of a Canadian society that might do things quite differently in terms of what it produces, how industry produces it and from what raw materials. We focused on things that are formulated out of biological solutions compared to things that might derive from fossil fuels.

We know, for instance, that Canadians and the government of Canada are very concerned about the toxic materials we find in our bodies now and our ecosystems, such as the Great Lakes or Prairie soils. We set a target of a 50-percent reduction in the use of harmful chemicals that accumulate in the environment or people's bodies, a significant objective to which biotech can contribute in various ways, not only with bioremediation, where plants like algae or trees are used to bind harmful chemicals in old mining or brownfield sites, but also by developing new industrial processes that use bioenzymes instead of existing industrial solvents, so you don't even produce the toxic chemical in the first place.

> "This move towards biofuels is certainly a success story for some corn farmers and operators of bioethanol refineries. Whether it's good for consumers and the environment, time will tell."

Why does the report look ahead to 2020?

Most environmentalists believe that 2020 to 2030 is a crucial time period. Many of the problems that we talk about now, such as climate change, loss of biodiversity and the build-up of toxic materials, will either be on their way to being solved by that time, or we will be facing very, very major costs and very, very major problems as a consequence of neglecting those problems.

Also, our experience with any kind of new technology is that it takes a minimum of 10 years, and sometimes up to 20 or 30, to create the necessary change in production methods and acceptance within society.

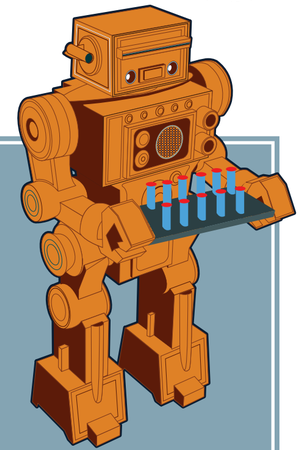
In the report, you recommend that Canadians adopt a "biowaste-to-bioproducts strategy". How would that work?

Canada is pretty well-endowed with waste, much of which ends up in landfills. How much waste can we turn into bioproducts – such as chemicals, plastics, or fuels – whether we use compostable waste from cities, agricultural waste such as manure, straw and corn stover, or residual material from logging or mill sites? And then, the question is, how do we turn it into bioproducts?

Are there any early 'bioproduct' success stories?

Most successes will appear in the next five to 10 years – the big ones. There are lots of efforts, especially in the US. DuPont has stated that they're moving towards greater use of biological sources for the raw materials they make into fibres and other products, and Cargill is building a large plant in Minnesota for producing plastics from biofuels. Other efforts have been stimulated by US subsidies for

(con't pg. 6)



applications are quite different from innovations such as the early genetically engineered crop introductions of the 1990s. These new applications are far more integrated into the mainstream of industrial and community activities and decisions. Most are multiple-step initiatives, where biotechnology and other innovations are introduced at various stages. Some stages involve genetically engineered organisms, others do not. Many applications, such as industrial enzymes, operate in closed environments, or, as in the case of genetically engineered vaccines, are unlikely to affect the natural environment.

Excerpted from* BioPromise? Biotechnology, Sustainable Development and Canada's Future Economy, *a report prepared for Canadian Biotechnology Advisory Committee (CBAC). A more detailed backgrounder and copies of the Executive and Technical reports may be obtained from

Just Imagine… in 2020…

A Canadian society where:

A flourishing rural economy supplies one-quarter of Canada's fuel, chemical and synthetic product needs from renewable biomass sources…

A 50 percent reduction occurs in the use of harmful chemicals that accumulate in the environment and in peoples' bodies…

A successful national strategy of "biowaste to bioproduct" is implemented in cities and rural communities across the country, based on the conversion of commercial food wastes, household compostable wastes, manure, aquaculture, agriculture and forest residues into biofuels and feedstocks for use in newer, cleaner chemical processes that reduce fossil fuel consumption…

A well-established and successful eco-efficiency effort exists within Canadian industries—partly based on the use of enzymes to prevent pollution and reduce material and energy use by three or four percent each year per unit of manufactured product…

An end occurs to contaminated industrial, mining and other "brownfield" sites, assisted by new biological remediation techniques for cleaning up past messes and treating current operations…

An effective national network is in place for monitoring the health of local ecosystems, relying not only on inexpensive biosensor monitoring tools, but also on the commitment and involvement of local communities and citizen groups…

A concerted effort by Canadian researchers, non-governmental organizations (NGOs), businesses, and government officials leads to new vaccines, crop varieties and environmental technologies needed to meet the Millennium Development Goals for global sustainable development—including biological control for human, fish, plant and livestock diseases; drought-resistant crop varieties; and advanced water pollution control for communities and industry.

These actions are driven by a growing realization of the magnitude of environmental and development challenges Canada and the world face. Our society embraces rigorous principles to reduce and eliminate environmental damage, and to improve quality of life.

Biotechnology is a major contributor to each of these seven imagined 2020 outcomes—a means to achieve important sustainable development goals of environmental quality, new economic opportunities and improved quality of life for Canadians and people elsewhere. But these new biotechnology

bioethanol. This move towards biofuels is certainly a success story for some corn farmers and operators of bioethanol refineries. Whether it's good for consumers and the environment, time will tell. We were not impressed either by the economics or the net benefits of current biofuel technology. From our point of view, many prototypes for what we call 'biorefineries' already exist in Canada, for example in the pulp and paper sector. Scientists at the University of BC and other locations have demonstrated that a variety of products can be produced from waste streams, and over time, new uses of pulp fibre could lead to valuable bioproducts. Given the amount of wood likely to fall prey to bark beetles during this time of global warming, there are likely to be large sources of dead wood – not only in BC, but perhaps in other parts of Canada.

We think that many new biorefineries could be located in rural areas to help stimulate rural economic development. They would be on a smaller scale than existing oil and gas refineries, at least initially, and could become economical within the coming 10 years. They would produce raw materials that could be manufactured into everything from fabric to plastic containers and fine chemicals.

The report includes an extensive section on "Principles and Values." Why was that important?

Much of our report is based around three key elements: values and ethics, Canadians' concern for a healthy community and a healthy environment, and the need to develop a more robust governance system for addressing biotechnology in the context of sustainable development.

At the moment, the oceans are more or less a 'happy hunting ground'. For example, people are interested in microbial life that manages to survive near sulphurous underwater vents off Vancouver Island. Life that can survive under these conditions has genetic material that is of great interest to those designing enzymes capable of being used in high-temperature, high-pressure industrial processes. There is also great interest in arctic creatures adapted to living in very cold sea conditions.

The study also identified a need for more international cooperation.

We highlight the need to examine biotech possibilities for helping to achieve the Millennium Development Goals set out by the UN to alleviate poverty and strengthen quality of life. Here, Canada has some real advantages, for example in our capacity to develop and produce vaccines, some of which involve biotechnology. Other major opportunities include environmental technologies for producing clean drinking water, environmental monitoring equipment, and fish vaccines.

Quite a bit of hype surrounds certain biotechnologies – how do you know which ones will pan out?

We see are a lot of assertions made about some biotechnologies and their positive impact for sustainable development. We don't know whether those assertions are really going to pan out or not, or what the risks might be.

We need to put screens in place – we would argue not just Environmental Assessment, but also a Sustainable Development Assessment –

> "Our working party tried to be 'cautiously neutral' in our examination of biotechnology and sustainable development. It was not our role to be promoters."

We chose to base our ethical framework – an ethics of the environment – on what's called "The Natural Step", which lays out a set of conditions under which we might live more sustainably and which in general involves two things: reducing the amount of stuff that we take out of the earth's crust and reducing toxicity in the environment. We also applied an ethical approach towards the whole process of how we deal with the introduction of a new technology. We chose to use the principles that have informed the Queensland, Australia, "Code of Ethical Practices for Biotechnology", which focuses on questions of integrity and equitable access to resources.

Being driven by a strong set of ethical values will make the adoption of biotechnology for sustainable development much more likely.

How do you deal with the question of equitable access to resources?

There's considerable concern by people in third world countries who have a high biodiversity base and see bioprospectors wandering around, whether it's to find plant characteristics that could be used for medical purposes, or more and more, specific characteristics for industrial products.

There is clearly a move towards addressing issues of access to use of biodiversity. Much of the dialogue is being carried out under the Global Convention on Biological Diversity and other international agreements. But the focus is mainly on dialogue between richer nations and developing nations. More attention needs to be focused on equitable access within Canada, in relation to local biodiversity on land, and access to Canada's rich marine biodiversity.

that give a full picture of the benefits, costs and likely levels of risk. We should be doing that when we start supporting R&D. At various points, as those R&D efforts show more promise, we can subject them to fairly simple analyses to understand whether we're likely to get benefits or not.

That's why we're recommending a governance system based on adaptive planning and management. It requires having more information than we have now (for example baseline studies of ecosystems) so we can anticipate the negative impacts, if any, of introducing new biotechnologies and new processing techniques. If we expect surprises, we can be prepared for them.

The report's title carries a question mark. Is the EWP ambivalent about biotechnology's potential to help achieve sustainable development goals?

Our working party tried to be 'cautiously neutral' in our examination of biotechnology and sustainable development. It was not our role to be promoters.

We contend that there is considerable potential to use biotechnology applications for addressing some of our most pressing environmental problems. But without care in how we go about it, the baby may be thrown out with the bath water, or at least have a very long bath! Much will depend upon public acceptability, and also on better organization of governmental response to set the right conditions. Our question mark relates to two matters: Will we be able to adequately answer the question of what really will give environment and sustainable development benefits at acceptable levels of risk? And will we have the ability to organize for ensuring that good initiatives will move forward to Canada's benefit in a timely and publicly acceptable fashion?

Upcoming Events

MAY 24–26 2007
Nobody's Child, Everybody's Children: An International Conference on New Reproductive and Genetic Technologies, Nanaimo

MAY 30 2007
Paediatric Bioethics Conference, TorontoPaediatric Bioethics Conference, Toronto

MAY 30–JUN 2 2007
2007 Annual Meeting – International Biobanking Standards, Singapore

MAY 30–JUN 3 2007
Joint 2007 Annual Meetings of the Agriculture, Food, and Human Values Society (AFHVS) and the Association for the Study of Food and Society (ASFS), Victoria

MAY 30–JUN 3 2007
Ethics Matters – Joint Ethics Conference of the 18th Canadian Bioethics Society Conference and the 3rd International Conference on Clinical Ethics and Consultation, Toronto

JUN 1–2 2007
Risk, Vulnerability, Uncertainty, Technology and Society: The 2007 International Symposium on Technology and Society (ISTAS)

JUN 11–12 2007
IX Annual Swedish Symposium on Biomedicine, Ethics and Society, "Searching for the Animal of Animal Ethics", Sweden

JUN 14–16 2007
Engineering European Bodies: When Biomedical Technologies Challenge European Governance, Bioethics and Identities, Austria

JUN 17–22 2007
Genomics and Globalization, the Netherlands

In the report, you state that "Canada is not moving quickly enough to set conditions in place that are attractive to biorefinery investors". What can be done to give Canada a comparative advantage?

We have to ensure that the federal government, through coordination with provincial governments, provides the enabling circumstances for biorefineries and sustainable development to be linked, and for specific initiatives to move forward. This means sending clear signals about the interest of using biotech for this purpose, ensuring that the regulatory and scientific framework is in place so that decisions are made in a timely and credible way, and that appropriate, time-limited incentives are in place.

There must also be continued investment in science, and coordinated efforts to send signals attractive to private sector investments. It also means making some key choices about whether to focus on advanced technologies such as cellulosic ethanol, which uses crop residues, and on areas where we may have a comparative advantage, such as in the transformation of pulp mills into biorefineries that can produce a broader range of products. I want to emphasize that government cannot choose all the winners, nor can it take over the responsibilities of the private sector. But without a focused effort and key decisions being made by federal and provincial bodies, the full potential of biotech and sustainable development will not be felt.

At the same time, we must recognize that some science has been neglected, especially developing a credible understanding of baseline ecological conditions that need to be understood and monitored if we are to properly assess biotech for sustainable development. Also, and very importantly, the federal government needs to develop what we call a "deliberative dialogue" on specific issues for biotech and sustainable development.

This means moving beyond the useful websites and other information tools, to building a better understanding of people's concerns, and to enhance public learning. We believe such processes involve two-way dialogue, and need to be carried out on a continuous basis rather than in crisis mode, which is what developed in the case of GM foods. It is particularly important that such dialogue occur with younger people, who will have to understand and react to unprecedented levels of environmental challenge, and very advanced science and technology options in the years and decades ahead. ❖

INVITATION TO READERS

Do you find this Newsletter interesting? What is your perspective on ethical, environmental, economic, legal and social impacts of genomics and proteomics? Would you like to receive more copies and distribute it to colleagues and friends?

Drop us a line at info@genomecanada.ca.

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