



**NETWORKS OF CENTRES OF EXCELLENCE**  
*Annual Report 2003/2004*  
*Shaping the Future*

Canada





## NETWORKS OF CENTRES OF EXCELLENCE

### *Annual Report 2003/2004*

*Shaping the Future*

The Networks of Centres of Excellence (NCEs) mobilize research talent across Canada and apply it to creating social and economic benefits for all Canadians. The NCEs foster partnerships of business, education and government to accelerate the exploitation of knowledge, research and technology, and to speed their transfer to the marketplace and to the public.

National and international in scope, the NCEs include thousands of highly qualified personnel, from postdoctoral fellows to world leaders in the most sophisticated fields of research. With more than a thousand partners, they have contributed to significant

advances in disciplines ranging from genetic research to child development and literacy. And, to prepare for Canada's future needs, the NCEs have contributed to the education, training and employment of thousands of university graduates.

The NCEs have made real differences to the lives of Canadians. The NCE 2003–2004 Annual Report illustrates in detail how their investments have paid off handsomely in economic and social benefits, and in Canada's quality of life.

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## A MESSAGE FROM THE CHAIR

Welcome to the 2003-2004 Networks of Centres of Excellence (NCE) Annual Report. As the NCE program approaches its 15<sup>th</sup> anniversary, this has been an active year – five networks completed their funding cycles, two new networks are establishing themselves and new teams of researchers are applying for funding in 2005.

Over the last decade and a half, our mission has been to mobilize Canada's research talent in academic, private and public sectors and apply it to solve large-scale important problems. This mobilization is not only within networks, but among networks as well. This was clearly demonstrated by the fact that three networks – CANVAC, PENCE and MITACS – became involved in research to combat Severe Acute Respiratory Syndrome (SARS). These networks were flexible and capable of quickly mobilizing scientists to respond to emerging challenges.

Two new networks created in the past year are ArcticNet and Advanced Foods and Materials Network (AFMNet). Both are timely and forward-looking enterprises. Climate warming in the Arctic will have a profound effect on life in the Far North – and throughout North America – and research is needed to understand the environmental, social and economic impacts this change will bring. AFMNet will develop novel ideas in food safety, nutritional quality and human health. It will boost Canada's capacity to create new knowledge in areas that are important for the public, provide intellectual stimulation for students and generate valuable intellectual property.

Overall this year, the NCE program supported the research of 1,962 professors in 78 Canadian universities. The program's partners included 719 Canadian companies, 215 provincial and federal government departments and 272 agencies from Canada, along with 352 international partners, making it a truly national and international program. The NCE program stimulated outside investments of over \$58 million, including more than \$23 million from private sector companies. With the program's own investment, the total dedicated to research, training and commercialization was more than \$136 million.

The NCE fostered commercialization of research last year by filing 105 patents, 31 of which have already been issued. Nineteen licences were granted and another 30 are being negotiated. Eleven spin-off companies were established – all in areas of high economic and social value. Our researchers published more than 3,500 papers in refereed journals. Perhaps most important, the NCEs helped shape the future for Canadian prosperity by training 4,881 research staff such as postdoctoral fellows, students, research associates and technicians to carry our strategy forward.

Designed as a partnership initiative of Industry Canada and the granting agencies – Science and Engineering Research Canada (NSERC), the Canadian Institutes of Health Research (CIHR) and the Social Sciences and Humanities Research Council (SSHRC) – the NCE program continues to meet its objective of improving the economy and our quality of life. This is made possible thanks

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to the support of universities, which are providing the networks with critical infrastructure and research personnel.

The achievements realized over the past year were a direct result of the vision and rigorous work of the scientific directors and the chairs of the boards of directors, who forged partnerships with research leaders from all sectors and across all disciplines. I want to thank them for their inestimable contributions. In doing so, I know I speak also for CIHR President Dr. Alan Bernstein and SSHRC President Dr. Marc Renaud.

I would also like to thank the Honourable David Emerson, Minister of Industry, and his predecessor, the Honourable Lucienne Robillard, for their support of the NCE Program.

Thomas A. Brzustowski  
Chair  
NCE Steering Committee



## THE NETWORK OF CENTRES OF EXCELLENCE PROGRAM:

*Our mission is an excellent one*

Simply put, the NCE program exists for one reason: to make Canada stronger.

It accomplishes this by encouraging excellence in research, building bridges between the best and brightest scientists who are doing that research, and enabling their outstanding work to make it to the marketplace so it can improve our quality of life and energize our economy.

The networks promote partnerships between researchers by empowering multi-disciplinary, collaborative "What if?" approaches to meet the scientific challenges of the 21<sup>st</sup> century –

whether they be in the fields of health, manufacturing, natural resources or advanced technology.

Call it knowledge translation, technology transfer or just clearing the path of obstacles that prevent academic investigation from becoming real-life application, the NCE program ensures that scientific innovation makes it out of the laboratory and into the world, where it can do the most good.





## THE NCE PROGRAM

*Innovation echoes across the country*

The silo mentality does not work in science. Doing remarkable research in isolation and storing the results has little or no impact on driving the economy or improving quality of life. The NCE program is built on the premise that when innovation is shared it increases exponentially.

Before the formation of the Canadian Water Network (CWN), collaboration on ensuring and improving the quality of drinking water was somewhat lacking. "We were working in our own silos," said Dr. Judy Isaac-Renton, Director of Laboratory Services for the BC Centre for Disease Control, who is now working on three research projects with Dr. Hans Schreier, a professor at the University of British Columbia's Institute for Resources, Environment & Sustainability. "Here were Hans and I living in the same city for 25 years and working for the same university, and never knowing we had a similar professional interest."

Dr. Mary Chipman, a professor of Epidemiology and Biostatistics at the University of Toronto's Department of Public Health Sciences, tells a similar story: "It was during one of the first meetings to discuss the NCE program that I became aware of the various scientific disciplines involved in automobile-related research. I thought I was pretty well connected across Canada, but these were people I had never met before. It was very sobering to learn how isolated we had all been." Dr. Chipman, a principal investigator with AUTO21 is working with a cross-Canada team of engineers and epidemiologists to examine

all aspects of side-impact crashes. "The cause of any traffic crash is an interaction between the driver and the vehicle and the surrounding environment. No one scientific discipline can come up with a solution. That's the real strength of AUTO21. They are aggressively multidisciplinary when it comes to finding and implementing solutions."

For Stem Cell Network (SCN) investigator Dr. Eric Jervis, the network model "de-isolated" his work at the University of Waterloo where, as a chemical engineer, he was doing innovative imaging of cells. "It brought me into a family of researchers, with the support and structure to allow collaboration to happen. Now the interaction is just like it would be if I was at the same larger schools as these researchers." He is now working on projects with the top stem cell scientists in the country, trying to find cures for Parkinson's and other degenerative diseases.

Networking also allows for more flexibility in adjusting to scientific needs as they arise. When Severe Acute Respiratory Syndrome (SARS) struck Toronto, the Canadian Protein Engineering Network (PENGE) mobilized \$300,000 in funding for research towards identifying validated targets for therapeutics, as well as lead compounds and libraries of drug candidates. "Our ability to quickly commit and deploy almost 10 percent of our annual research funding highlights how a pre-established network of researchers can rapidly respond to national emergencies," said Dr. Stephen Withers, CEO and Scientific Director of PENGE.

## THE NCE PROGRAM

*How the brightest become the best*

*"Through my work with the Canadian Stroke Network (CSN), I anticipate forming collaborative scientific efforts to forge ahead in stroke research, with the ultimate hope of making the lives of stroke survivors better. For me, being a CSN trainee is a privilege that comes with the responsibility of utilizing and contributing to its resources, so all of us perform to our best. Obviously, being a CSN trainee is of priceless value."*

**Andy Shih**

Ph.D. candidate at the University of British Columbia

The NCE program believes our best young minds should be inspired, encouraged and enabled to shape the future and build a better world. To that end, networks across the country are engaging the next generation of superlative scientists to work with the best in their fields.

Each year, hundreds of NCE-sponsored graduate students move on to roles in industry, academia and government to ensure that Canada not only remains competitive in the global marketplace but leads the way in making research breakthroughs, developing astute public policy and improving the overall quality of life.

"The highly qualified personnel we created are still very actively sought out," said Dr. C. André Salama, Scientific Director of Micronet, the University of Toronto-hosted microelectronics network that is completing a 14-year term with the NCE. "The number we are processing for graduate degrees is up 20 percent. Graduate students are able to get jobs – they are in high demand."

The individual networks encourage young scientists to take a multidisciplinary approach to their research and to consider a broad range of possible applications for its use. For example, the Canadian Institute for Photonic Innovations (CIPI), which produced 36 postgraduate degrees and had 215 students working on network research in 2003-2004, stresses that a career in photonics now requires much more than skills limited to electrical engineering and physics. It encourages photonics students, once preoccupied with telecommunications, to embrace applications in biotechnology, medicine, transportation and manufacturing.

That same multidisciplinary approach holds true for the Mathematics of Information Technology and Complex Systems (MITACS) network, which has some 450 students involved in its projects. The network, whose goal is to drive the recruiting, training and placement of a new generation of highly mathematically skilled personnel vital to Canada's future social and economic well being, is dedicated to creating a core of mathematical scientists armed with powerful computational and analytical tools and experience in applying mathematics in an interdisciplinary context. Those skills will be needed in everything from charting the spread of disease to making automobiles less likely to crash.

Given that the challenges of tomorrow will be taken up by today's brightest young minds, the NCE program is committed to training the next wave of researchers to excel in areas critical to Canada's continued productivity and economic growth. But it goes beyond the subject studied and into the philosophical approach to scientific research.

"It's not just training the students," said Paul Johnston, Managing Director of the Institute for Robotics and Intelligence Systems (IRIS). "It's teaching them how to go out, start or join a company, and create technologies that are useful to others. We've helped create a transformation in that attitude."





## THE NCE PROGRAM

*The only constant is change*

The NCE program is evolving constantly. New networks are born; established ones are reviewed and go through renewal processes to ensure excellence of operation. Some complete their funding cycles and emerge as self-sustaining agencies, carrying on their networking to improve the economy.

In 2003-2004, two new networks were approved for funding, both aimed at shaping a better future for Canada:

- ArcticNet, still in its first year, already has researchers participating in the largest-ever health survey of the Inuit. With a mission to investigate the environmental, social and economic consequences of the polar ice melt, the network is contributing three complementary research projects and funds to operate the retrofitted *CCGS Amundsen*, which serves as a floating lab and medical clinic.
- The Advanced Foods and Materials Network (AFMNet), is bringing together natural scientists, engineers, health researchers, social scientists and lawyers to work on various facets of food and bio material advances. Given the huge focus on genetically modified foods, AFMNet is securing the future by creating the next generation of multidisciplinary scientists and researchers.

Meanwhile, the Mechanical Wood-Pulps Network (MWPN) has completed its research management funding stage with the NCE program and is evolving into the Canadian Pulp and Paper Network for Innovation in Education and Research (PAPIER). With infrastructure support from Paprican, the pulp and paper industry's R&D arm, PAPIER is building on existing networking strengths. It will serve as the single point of access for the pulp and paper industry to tap the research capacity of Canada's universities. This builds on MWPN's success in generating considerable

knowledge to commercialize innovative products and processes.

**How new networks are born**

The NCE program mobilizes Canada's research talent in the academic, private and public sectors to achieve economic growth, create jobs, advance knowledge and improve quality of life.

**Program Criteria**

Proposals for funding are assessed against five criteria:

- The excellence of the research program;
- The opportunity for developing highly qualified personnel;
- The networking and partnership possibilities;
- The opportunity for knowledge exchange and technology exploitation; and
- The quality of the management of the network.

**The NCE peer-review process**

To ensure excellence and fairness, the NCE program uses a peer-review system in which a Selection Committee of international experts works with an expert panel to make recommendations to the Steering Committee to decide which networks are funded.

**Eligible research**

Competitions are open to all research areas, however the Steering Committee may target specific areas, taking into consideration:

- The amount of funding available;
- The broad areas already represented in the existing networks; and
- The need to develop specific areas in accordance with national needs.

## THE NCE PROGRAM

*The results are healthy*

*“There really is a tremendous amount of expertise across the country and it is quite likely there will continue to be major breakthroughs leading to novel strategies to treat debilitating diseases such as diabetes as a result of the ongoing networking supported by the Networks of Centres of Excellence.”*

**Dr. Tim Kieffer**

Department of Physiology  
University of  
British Columbia

Given that seven of the 20 networks are directly involved in research to improve health and eradicate diseases, it is not surprising that so many key health developments have been made with the help of the NCE program.

As well, several non-health networks are bringing their expertise in other fields to bear on the health sciences and coming up with amazing results. For example, Dr. Brian Wilson, a laser biophysicist and a leading researcher with the Canadian Institute of Photonic Innovations (CIPI), is trying to find a way to attack cancer tumors without invasive – and potentially damaging – surgery. Based at the University of Toronto, Dr. Wilson is part of a CIPI team of researchers from the University of Calgary, McMaster University and the Université de Sherbrooke pushing back the boundaries of photodynamic therapy by using implanted, light-activated drugs to attack tumors but not the surrounding tissue.

In the field of immunological investigation, researchers at the Canadian Network for Vaccines and Immunotherapeutics (CANVAC) have found a pathway that triggers the immune system’s response to virus infection. Made by Drs. John Hiscott and Rongtuan Lin, both of McGill University,

the discovery of cellular proteins involved in stimulating the immune response could have important implications in the development of therapies to treat those infected by Human Immunodeficiency Virus (HIV), Hepatitis C and Severe Acute Respiratory Syndrome (SARS).

An international research team, led by Canadian Genetic Diseases Network (CGDN) scientists, has found that small variations in two genes make people more susceptible to leprosy. This revelation could hold the key to understanding why leprosy – called the disease of the poor, the underprivileged and marginalized by the World Health Organization – persists despite the fact that the bacteria that causes it can be killed with drugs.

Meanwhile, Canadian Stroke Network (CSN), is working with the Stem Cell Network (SCN) to combat a disease that strikes 50,000 Canadians each year. Their project, Adult Stem Cells to Repair Stroke, undertaken in partnership with the Institute of Circulatory and Respiratory Health and the Institute of Neurosciences, Mental Health and Addiction, involves researchers from across Canada investigating whether adult stem cells can generate new nerve cells in a brain damaged by stroke.

## THE NCE PROGRAM

*Out the lab door and into the world*

*"It's very rewarding as a researcher to see technology from a university being taken up by the private sector. I can't imagine that this technology would have been commercialized without the NCE. Their flexibility and goal-oriented approach really helps facilitate these types of partnerships with the private sector."*

**Dr. Douglas Thomson**  
Electrical and Civil  
Engineering Department  
University of Manitoba

While doing excellent research is a key component of the NCE program, commercializing that research so that industries can benefit and the country's economy is energized is just as important. Transferring knowledge and technology from academia to the private and public sectors helps solve problems, improve efficiency and reduce waste. It makes Canada stronger domestically and more competitive globally.

The individual networks achieve this goal through hard work and good instincts. In the field of manufacturing, AUTO21 research created a revolutionary engine-building process that, according to reports published in the spring of 2004, constitutes a major advancement for the automotive industry. Using a process developed by researchers at the University of Windsor, automakers can cut costs and produce more efficient engines by replacing steel sleeves in aluminum engines with specially hardened aluminum inserts.

"The knowledge that we're creating is getting patented, which means it will get into plants and be used and exported around the world," said Dr. Peter Frise, AUTO21's Program Leader and CEO.

Researchers at Intelligent Sensing for Innovative Structures (ISIS) designed a steel-free bridge deck, a technology that can reduce corrosion and maintenance costs – especially for northern climates in which outdoor structures are damaged by snow and ice. "This truly shows the effectiveness of ISIS, not just in research

and development for Canada, but also for rapid deployment globally." said Dr. Vistap Karbhari of the University of California at San Diego, referring to the successful construction of the first steel-free bridge deck in the United States by the Iowa Department of Transportation. "This should provide a clear example for other centres worldwide for technology transfer."

Knowledge transfer can mean money in the till for Canada's retail industry. GEOIDE funding has helped create a national database of the retail economy – a comprehensive listing of every store in the country – that is updated monthly with a particular focus on key retailers who control the economy. There is also a database of all the "power centres" across the country. Information is disseminated to industry by Rogers Media, a GEOIDE partner.

Meanwhile, the Stem Cell Network (SCN) is organizing now to capitalize on the economic benefits of future stem cell therapies. The SCN brokered an agreement among top scientists, universities and hospitals to collectively manage intellectual property and create a globally competitive stem cell company. The company will give researchers the critical mass needed to get products to market in the future.

These are but four examples of how the networks are achieving the goal of improving the economy, making life better and positioning Canada for greater prosperity in the future.

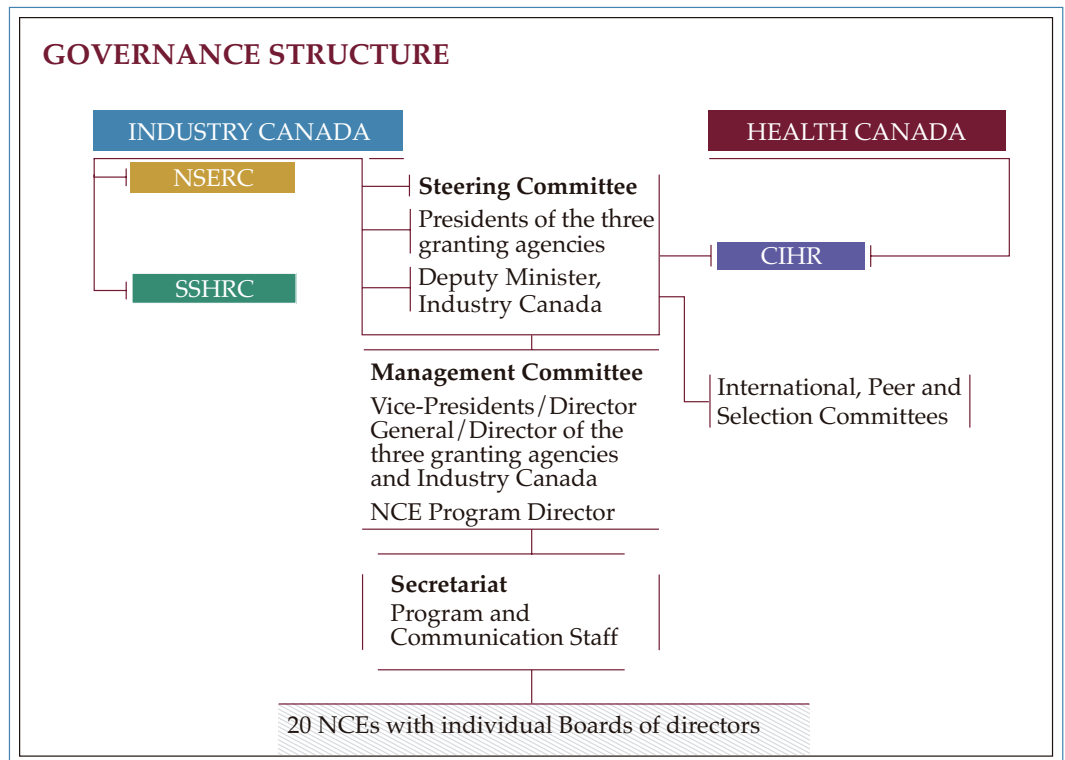
THE NCE PROGRAM

*How the NCE is governed*

Canada's three federal granting agencies – The Canadian Institutes for Health Research (CIHR), Science and Engineering Research Canada (NSERC) and the Social Sciences and Humanities Research Council (SSHRC) – jointly administer the NCE program in partnership with Industry Canada. The program is managed by a Steering Committee comprised of the presidents of the three granting agencies and the Deputy Minister of Industry Canada. The Steering Committee is assisted by the NCE Management

Committee, composed of the granting agencies' programs vice-presidents, the Industry Canada Innovation Policy Branch Director General, the NSERC Director of Policy and International Relations and the NCE Program Director.

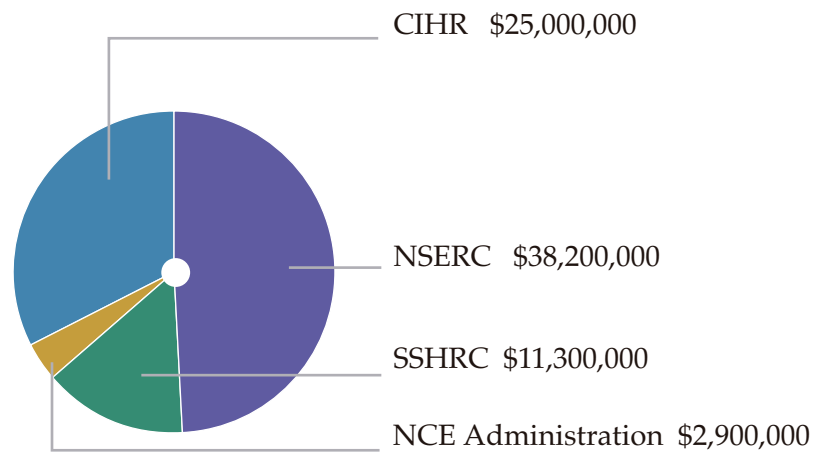
The NCE is a permanent program of the Government of Canada, receiving \$77.4 million in annual funding which is channelled through the three granting agencies.





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ADMINISTRATION OF NCE PROGRAM FUNDING



**Total \$77,400,000**





## THE YEAR'S HIGHLIGHTS

*How we shaped the future*

Research undertaken by NCE investigators over the past year touched – and will touch – all aspects of Canadian life, from making us better able to fight the outbreak of disease to improving our chances of surviving a stroke. Work done mapping maritime traffic will help the Canadian Coast Guard rescue more lives, while our woodlands will forever

be affected by a comprehensive study of the best practices in managing our forests. Efforts by NCE investigators over the past year will ensure that water is cleaner and safer, that automobile engines are lighter and more efficient and that the private sector exploits the industrial relevance of mathematics to improve productivity and profits.



## THE YEAR'S HIGHLIGHTS

*A record of accomplishment*

From research to collaboration to securing partnerships with industry, the NCE accomplished much in 2003-2004. Here is a small sample:

**March, 2004**

The **Canadian Network for Vaccines and Immunotherapeutics (CANVAC)** announces the start of a therapeutic HIV vaccine trial – the first clinical trial designed by academic Canadian researchers.

**February, 2004**

The **Canadian Language and Literacy Research Network**, with the National Literacy Secretariat, awards \$119,000 for two researchers to help improve children's literacy levels in Aboriginal communities in Prince Edward Island and Nova Scotia.

**AquaNet** and Fiskeriforskning, a world-class Norwegian aquaculture research institute, sign a three-year agreement to exchange scientists and work collaboratively.

**January, 2004**

An aquatic robot that can monitor underwater life and observe changes to a ship or oil platforms undergoes first tests, funded largely by the **Institute for Robotics and Intelligent Systems (IRIS)**.

**November, 2003**

A team of McGill University scientists, led by an investigator of the **Canadian Genetic Diseases Network (CGDN)**, announces a discovery in the fight against malaria — a genetic mutation that appears to prevent the malarial parasite from growing in red blood cells.

Allan Rock, Industry Minister, announces that Canada will invest \$22.2 million in a new Network of Centres of Excellence – the **Advanced Foods and Materials Network (AFMNet)**.

The **Canadian Institute for Photonic Innovations (CIPI)**, co-hosts Canada's first biophotonics primer and workshop, called BioLIGHT, for academic and industry researchers interested in developing and applying advanced photonics technologies.

The **Canadian Arthritis Network (CAN)**, with the Canadian Institutes of Health Research's Institute of Musculoskeletal Health and Arthritis announces \$4.4 million in funding for osteoarthritis research projects.

**October, 2003**

The **Geomatics for Informed Decisions (GEOIDE)** Network organizes a workshop on Airborne Techniques to Measure Coast Erosion for the Canadian Coastal Conference, and another on Sensor-Web Networks for Environmental Applications for the Remote Sensing Symposium.

**September, 2003**

The **Sustainable Forest Management Network (SFM)** publishes *Towards Sustainable Management of the Boreal Forest*, a 1,000-page book summarizing seven years of peer-reviewed ecological, economic and social research.

Leading international researchers convene in Banff, Alberta to exchange the latest knowledge about SARS and work together to determine future collaborative research topics. The event is jointly supported and coordinated by the **Mathematics of Information Technology and Complex Systems (MITACS)** Network and the Pacific Institute for Mathematical Sciences.

Dr. Aftab A. Mufti, President of the **Intelligent Sensing for Innovative Structures (ISIS)** Network outlines "Civionics," the meshing of electronics with the design of civil structures, at conferences in Japan and Italy.

**August, 2003**

Allan Rock, Minister of Industry, announces Canada will invest \$25.7 million over the next four years in **ArcticNet**, a new Canadian Network of Centres of Excellence.

**July, 2003**

**Micronet** announces four new partnerships: Cognio Canada Inc., Discera Inc., IDEE Technologies Inc. and Macroblock Inc.

**June, 2003**

A research team led by a **Stem Cell Network (SCN)** investigator publishes a groundbreaking study that demonstrates how a novel population of adult stem cells resident in muscle tissue plays an important role in muscle regeneration.

The **Protein Engineering Network of Centres of Excellence (PENCE)** and **CANVAC** are named to a public and private sector consortium for research on Severe Acute Respiratory Syndrome.

**May, 2003**

The **Canadian Stroke Network (CSN)** invests \$1.5 million in research to improve recovery from stroke, including \$700,000 for the creation of a national "gold standard" for post-stroke rehabilitation.

**April, 2003**

Research sponsored by the **Canadian Bacterial Diseases Network (CBDN)** forms the basis of a multiparty licence and a collaborative research agreement with Bioniche Animal Health Canada Inc. for the commercial development of a vaccine to prevent disease in cattle caused by *Haemophilus somnus* bacteria.

THE YEAR'S HIGHLIGHTS

*The power of partnerships: Overview*

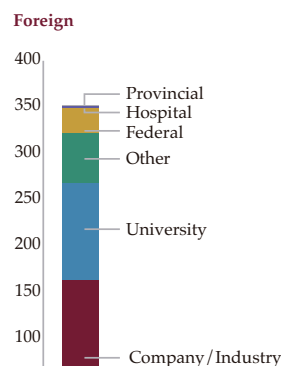
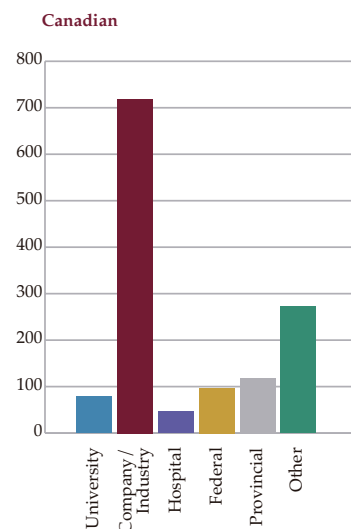
The NCE program's premise is that effective research calls for links between academia, federal and provincial agencies, and private sector participants. In 2003-2004, the NCE supported 1,589 researchers at work in 78 Canadian universities. Across the country, the networks partnered with 215 provincial and federal government departments,

47 hospitals and 272 other organizations, thereby accelerating the use of research results to benefit Canadians.

The networks also built partnerships with 877 Canadian and foreign companies to generate high quality research to meet the needs of industry.

REGIONAL AND SECTORAL DISTRIBUTION OF NCE PARTNERS

Province / Territory	University	Company/ Industry	Hospital	Federal	Provincial	Other	Total
NorthWest Territories, Nunavut, Yukon	5	21	1	4	2	5	38
British Columbia	12	105	5	7	14	33	176
Alberta	4	89	3	1	15	23	135
Saskatchewan	2	7	-	3	7	4	23
Manitoba	2	15	-	1	7	4	29
Ontario	23	326	20	61	29	137	596
Quebec	22	132	18	10	30	50	262
New Brunswick	4	13	-	7	8	8	40
Nova Scotia	-	3	-	1	1	3	8
Prince Edward Island	3	1	-	-	3	2	9
Newfoundland and Labrador	2	7	-	2	2	3	16
<b>Total Canadian</b>	<b>78</b>	<b>719</b>	<b>47</b>	<b>97</b>	<b>118</b>	<b>272</b>	<b>1,332</b>
<b>Total Foreign</b>	<b>105</b>	<b>163</b>	<b>2</b>	<b>27</b>	<b>1</b>	<b>54</b>	<b>352</b>
<b>Grand Total</b>	<b>183</b>	<b>877</b>	<b>48</b>	<b>124</b>	<b>117</b>	<b>324</b>	<b>1,673</b>





THE YEAR'S HIGHLIGHTS

*The power of partnerships: Industry*

*"We believe that the impact of the Canadian Institute for Photonic Innovations (CIPI) in developing engineers and scientists trained in the issues and techniques of modern photonics has been a significant benefit to our company during the growth phase of the industry. We anticipate that CIPI's research and training activities in photonics will lead to commercially significant outcomes during the recovery phase of the telecommunication industry."*

**Barrie Keyworth**  
 Director,  
 Wavelength Management,  
 JDS Uniphase

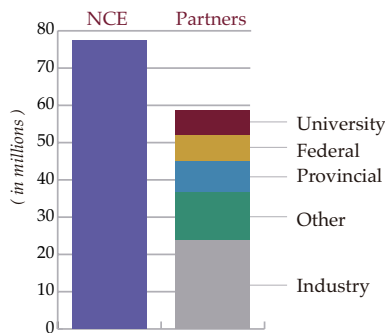
The NCE program does not stand on its own. It takes industry input to turn research into reality. The benefits work both ways: industry partners contribute funds and resources while the research they support helps them solve problems. That's the case with the Mathematics of Information Technology and Complex Systems (MITACS) network, which is using mathematics to help Ballard Power Systems Inc. develop its fuel cell technology. For its part, the

Institute for Robotics and Intelligent Systems (IRIS) benefits from Bell Canada's participation in its LEARN project to use algorithms to mine large amounts of data in a more efficient way.

As the chart below indicates, in-cash and in-kind contributions by industry partners amounted to almost a third of NCE funding and was the largest single source of contributions.

LEVERAGING SUPPORT

Source	Cash	In-Kind	Total
NCE	\$77,400,000	-	\$77,400,000
<b>Partners:</b>			
University	\$2,900,778	\$3,640,960	\$6,541,738
Federal	\$3,709,432	\$3,440,675	\$7,150,107
Provincial	\$7,174,572	\$1,290,068	\$8,464,640
Other	\$9,036,806	\$3,986,700	\$13,023,506
Industry	\$9,812,897	\$13,801,201	\$23,614,098
Partner's Total	\$32,634,485	\$26,159,604	\$58,794,089
<b>Grand Total</b>	<b>\$110,034,485</b>	<b>\$26,159,604</b>	<b>\$136,194,089</b>



\* Other partners include hospitals, research institutes, and not-for-profit organizations.





THE YEAR'S HIGHLIGHTS

*The power of partnerships: Academia*

From Memorial University of Newfoundland in St. John's to the University of Victoria on Vancouver Island in British Columbia, the NCE program has built solid, mutually beneficial relationships with 78 post-secondary and research institutions across Canada.

These universities, colleges and research institutes contribute essential elements of the NCE foundation, including:

- The salaries of the academic researchers;
- Research facilities;
- Support for network administration; and
- A unique pool of human-resources – students and postdoctoral fellows to be trained by the networks.

British Columbia	AFMNet	AquaNet	ArticNet	AUTO21	CAN	CANVAC	CBDN	CGDN	CIPI	CLLRNet	CSN	CWN	GEOIDE	IRIS	ISIS	Micronet	MITACS	PENCE	SCN	SFM	
Malaspina University College		✓																			
Okanagan University College																	✓				
Simon Fraser University	✓	✓		✓					✓	✓		✓	✓	✓		✓	✓	✓			✓
University College of the Cariboo		✓																			
University of British Columbia	✓	✓		✓	✓	✓	✓	✓		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
University of Northern British Columbia																	✓				✓
University of Victoria	✓	✓		✓			✓			✓			✓			✓	✓	✓	✓	✓	✓



Alberta	AFMNet	AquaNet	ArticNet	AUTO21	CAN	CANVAC	CBDN	CGDN	CIPI	CLLRNet	CSN	CWN	GEOIDE	IRIS	ISIS	Micronet	MITACS	PENCE	SCN	SFM	
University of Alberta	✓		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
University of Calgary	✓			✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
University of Lethbridge									✓		✓	✓	✓							✓	

Saskatchewan	AFMNet	AquaNet	ArticNet	AUTO21	CAN	CANVAC	CBDN	CGDN	CIPI	CLLRNet	CSN	CWN	GEOIDE	IRIS	ISIS	Micronet	MITACS	PENCE	SCN	SFM	
University of Regina				✓					✓			✓				✓	✓				✓
University of Saskatchewan	✓					✓	✓			✓	✓	✓	✓	✓	✓	✓	✓	✓			✓

Manitoba	AFMNet	AquaNet	ArticNet	AUTO21	CAN	CANVAC	CBDN	CGDN	CIPI	CLLRNet	CSN	CWN	GEOIDE	IRIS	ISIS	Micronet	MITACS	PENCE	SCN	SFM	
University of Manitoba	✓		✓	✓	✓	✓	✓	✓	✓		✓	✓	✓		✓	✓	✓	✓			✓
University of Winnipeg																					✓



Ontario	AFMNet	AquaNet	ArticNet	AUTO2I	CAN	CANVAC	CBDN	CGDN	CIP1	CLLRNet	CSN	CWN	GEOIDE	IRIS	ISIS	Micronet	MITACS	PENCE	SCN	SFM	
Brock University										✓		✓									
Carleton University				✓					✓	✓		✓	✓	✓	✓	✓	✓	✓			
Huron University College										✓											
Lakehead University	✓			✓										✓							✓
Laurentian University													✓								
McMaster University	✓	✓		✓	✓	✓	✓		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	
Nipissing University				✓																	
Queen's University		✓		✓	✓		✓		✓	✓	✓	✓	✓	✓	✓		✓	✓	✓		
Royal Military College of Canada				✓								✓	✓								
Ryerson Polytechnic University	✓			✓								✓	✓			✓					✓
Trent University																					✓
University of Guelph	✓	✓		✓	✓		✓			✓		✓	✓	✓			✓	✓			✓
University of Ontario Institute of Technology				✓																	
University of Ottawa	✓	✓		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		✓			✓	✓
University of Toronto	✓			✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
University of Waterloo	✓	✓		✓	✓	✓			✓	✓		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
University of Western Ontario	✓			✓	✓	✓	✓		✓	✓	✓		✓	✓			✓	✓	✓	✓	✓
University of Windsor				✓					✓			✓	✓			✓					
Wilfrid Laurier University		✓		✓					✓	✓		✓	✓					✓			
York University				✓			✓		✓	✓			✓	✓			✓				



Québec

	AFMNet	AquaNet	ArticNet	AUTO21	CAN	CANVAC	CBDN	CGDN	CIP1	CLLRNet	CSN	CWN	GEOIDE	IRIS	ISIS	Micronet	MITACS	PENCE	SCN	SFM
Concordia University		✓		✓	✓					✓	✓		✓	✓	✓	✓	✓		✓	✓
École des Hautes Études Commerciales				✓													✓			
École Polytechnique de Montréal				✓	✓				✓			✓		✓	✓	✓	✓			
Institut des sciences de la mer à Rimouski													✓							
Institut national de la recherche scientifique		✓			✓							✓								
Eau, Terre et Environnement		✓											✓							
Énergie et Matériaux					✓				✓							✓				
Géoresources / Centre Géoscientifique de Québec													✓			✓				
Institut Armand-Frappier					✓							✓								
Télécommunications									✓											
Urbanisation													✓							
McGill University	✓			✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓	✓	✓
Université de Montréal	✓	✓		✓	✓	✓		✓	✓	✓	✓	✓	✓	✓		✓	✓	✓	✓	✓
Université de Sherbrooke	✓			✓	✓	✓		✓				✓		✓	✓	✓	✓			✓
Université du Québec à Chicoutimi																				✓
Université du Québec à Montréal						✓			✓			✓					✓			✓
Université du Québec à Rimouski		✓																	✓	✓
Université du Québec à Trois-Rivières				✓								✓					✓			✓
Université du Québec en Abitibi-Témiscamingue																				✓
Université du Québec en Outaouais									✓			✓				✓				
Université Laval	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓			✓		✓	✓

Institut National de la recherche scientifique



New Brunswick	AFMNet	AquaNet	ArticNet	AUTO21	CAN	CANVAC	CBDN	CGDN	CIPi	CLLRNet	CSN	CWN	GEOIDE	IRIS	ISIS	Micronet	MITACS	PENCE	SCN	SFM	
Mount Allison University		✓							✓												
Université de Moncton	✓	✓								✓			✓								✓
University of New Brunswick	✓	✓		✓					✓			✓	✓				✓				✓

Nova Scotia	AFMNet	AquaNet	ArticNet	AUTO21	CAN	CANVAC	CBDN	CGDN	CIPi	CLLRNet	CSN	CWN	GEOIDE	IRIS	ISIS	Micronet	MITACS	PENCE	SCN	SFM	
Acadia University										✓		✓					✓				
Dalhousie University	✓	✓		✓			✓		✓	✓	✓	✓	✓	✓	✓	✓	✓		✓	✓	
Nova Scotia Agricultural College		✓										✓									
Saint Mary's University		✓										✓	✓				✓				
St. Francis Xavier University	✓	✓			✓		✓		✓												

Prince Edward Island	AFMNet	AquaNet	ArticNet	AUTO21	CAN	CANVAC	CBDN	CGDN	CIPi	CLLRNet	CSN	CWN	GEOIDE	IRIS	ISIS	Micronet	MITACS	PENCE	SCN	SFM	
Atlantic Veterinary College		✓																			
University of Prince Edward Island		✓			✓					✓	✓	✓									

Newfoundland and Labrador	AFMNet	AquaNet	ArticNet	AUTO21	CAN	CANVAC	CBDN	CGDN	CIPi	CLLRNet	CSN	CWN	GEOIDE	IRIS	ISIS	Micronet	MITACS	PENCE	SCN	SFM	
Memorial University of Newfoundland	✓	✓			✓					✓	✓	✓	✓	✓			✓		✓	✓	✓





#### THE YEAR'S HIGHLIGHTS

### *Transforming knowledge into practice*

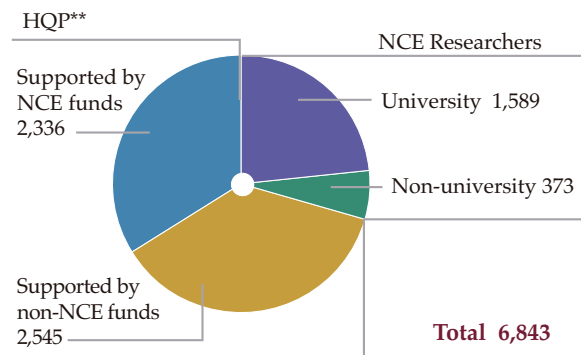
It starts with a good idea. Then the idea gets tested. Findings are recorded, data collected and, after considerable hard work, a scientific paper is published. "If we don't publish what we are doing, we might as well not do it, we might as well not exist," said Dr. Michael Rudnicki, a principal investigator with the Stem Cell Network. "We have to share it with the world."

There are 6,843 highly qualified professionals – researchers in academia, industry, government and other organizations, as well as research associates, postdoctoral fellows

and graduate students – who work with the NCE, developing their ideas. In 2003-04, they shared them with the world by authoring 3,564 refereed publications.

It didn't stop there. Committed to the goal of transforming "what we know" into "what we can use," those same scientists filed for 105 patents, of which 31 have already been issued. As well, 19 licences have been granted and a further 30 are under negotiation. Eleven spin-off companies were also established, ready to put good ideas to good use.

Province / Territory	NCE Researchers*			HQP**			Total Personnel
	University	Non-university	Total	Supported by NCE funds	Supported by non-NCE funds	Total	
British Columbia	272	32	304	293	370	663	967
Alberta	263	16	279	327	348	675	954
Saskatchewan	41	7	48	27	25	52	100
Manitoba	31	18	49	55	69	123	172
Ontario	577	231	808	926	893	1,819	2,627
Quebec	295	63	358	563	689	1,252	1,610
New Brunswick	39	2	41	55	51	107	148
Nova Scotia	44	3	47	66	54	120	167
Prince Edward Island	16	1	17	10	27	37	54
Newfoundland	11	-	11	15	18	33	44
<b>Total Canadian</b>	<b>1,589</b>	<b>373</b>	<b>1,962</b>	<b>2,336</b>	<b>2,545</b>	<b>4,881</b>	<b>6,843</b>
<b>Total Foreign</b>	<b>48</b>	<b>55</b>	<b>103</b>	<b>1</b>	<b>6</b>	<b>7</b>	<b>110</b>
<b>Grand Total</b>	<b>1,637</b>	<b>428</b>	<b>2,065</b>	<b>2,337</b>	<b>2,551</b>	<b>4,888</b>	<b>6,953</b>



\* An NCE researcher is a researcher from the academic, public or private sector responsible for certain aspects of a network-funded research project.

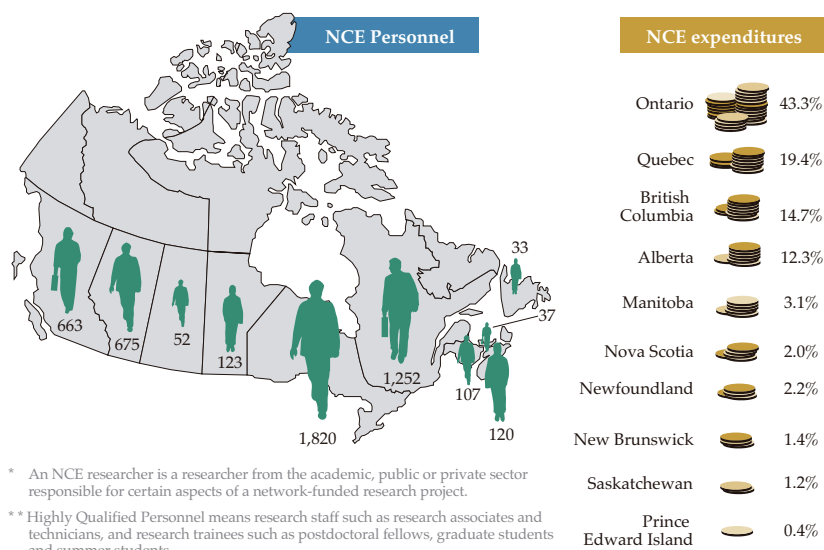
\*\* Highly Qualified Personnel means research staff such as research associates and technicians, and research trainees such as postdoctoral fellows, graduate students and summer students.

The regional distribution of NCE funds are expenditures reported by each participating network institution in 2003-04.

These expenditures are drawn against NCE funds provided in 2003-04 and carried over from previous years.

## REGIONAL DISTRIBUTION OF NCE PERSONNEL AND FUNDS

Province / Territory	NCE Researchers*		HQP**		NCE expenditures	
	Total	Percentage	Total	Percentage	Total	Percentage
British Columbia	304	15%	663	14%	\$10,735,283	14.7%
Alberta	279	14%	675	14%	\$8,945,646	12.3%
Saskatchewan	48	2%	52	1%	\$865,558	1.2%
Manitoba	49	2%	123	3%	\$2,258,539	3.1%
Ontario	808	39%	1,819	37%	\$31,560,150	43.3%
Quebec	358	17%	1,252	26%	\$14,106,163	19.4%
New Brunswick	41	2%	107	2%	\$1,047,544	1.4%
Nova Scotia	47	2%	120	2%	\$1,472,918	2.0%
Prince Edward Island	17	1%	37	1%	\$255,791	0.4%
Newfoundland	11	1%	33	1%	\$1,600,428	2.2%
<b>Total</b>	<b>1,962</b>	<b>95%</b>	<b>4,881</b>	<b>100%</b>	<b>\$72,848,020</b>	<b>100%</b>
<b>Total Foreign</b>	<b>103</b>	<b>5%</b>	<b>7</b>	<b>-</b>	<b>-</b>	<b>-</b>
<b>Grand Total</b>	<b>2,065</b>	<b>100%</b>	<b>4,889</b>	<b>100%</b>	<b>\$72,848,020</b>	<b>100%</b>



\* An NCE researcher is a researcher from the academic, public or private sector responsible for certain aspects of a network-funded research project.

\*\* Highly Qualified Personnel means research staff such as research associates and technicians, and research trainees such as postdoctoral fellows, graduate students and summer students

The regional distribution of NCE funds are expenditures reported by each participating network institution in 2003-04. These expenditures are drawn against NCE funds provided in 2003-04 and carried over from previous years.



THE YEAR'S HIGHLIGHTS

*High-quality people make Canada competitive*

*"The future of the Canadian automotive sector depends on those pursuing post-secondary education today. The AUTO21 projects to which the student researchers contribute are influencing everything from vehicle materials and manufacturing processes to fuel cell technologies, vehicle safety, and policy and regulations."*

**Dr. Peter Frise**  
 AUTO 21 Program Leader  
 and CEO

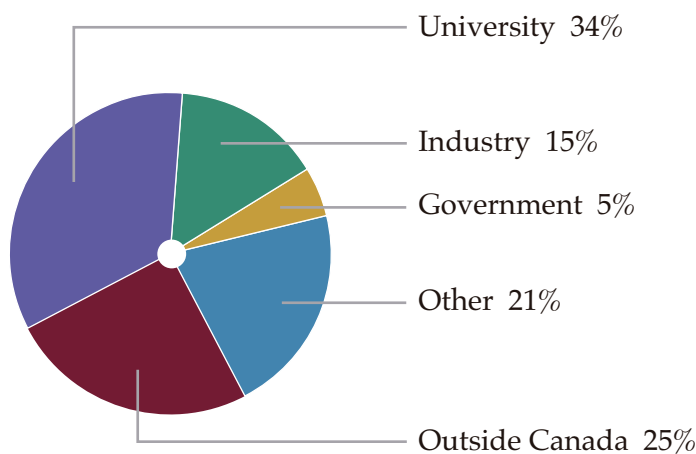
The NCE program mobilizes Canada's research talent in the academic, private and public sectors and applies that talent to the task of developing the economy and improving the quality of life for Canadians. To do so requires developing world-class researchers in areas essential to productivity and economic growth.

Every network in the program is committed to training and retaining outstanding researchers. Given that innovations in one field can have applications in entirely different areas, trainees are encouraged to take multidisciplinary and multisectoral approaches in their research. The result can be seen at the Institute for Robotics and Intelligent Sensing (IRIS), where a project is underway to develop computational methods to analyze gene expression – using robotics expertise to do innovative work to help medical science.

NCE program trainees are also encouraged to consider the social and ethical impact of their work in addition to the economic implications. That is why the Advanced Food and Materials Network (AFMNet) is not only investigating the health implications of using genetically modified foods but also researching the factors affecting consumer acceptance of these foods with regard to moral, religious and cultural issues.

The chart below shows that after their NCE training, 15 percent of students find work in an industry related to their field of studies while 34 percent continue working in academia. Government and other sectors are also employers of choice for NCE-trained scientists.

POST-NETWORK EMPLOYMENT BY SECTOR





## THE YEAR'S HIGHLIGHTS

*New networks on the horizon for 2005*

The NCE program is constantly renewing itself to ensure its research remains highly relevant. As the older networks transition out, new ones are born. New networks are chosen on the basis of their ability to do excellent research, develop highly qualified personnel, build partnerships to expand the application of their work across many areas and transfer the knowledge into commercial use to benefit the economy and improve life.

Applicants compete for NCE funding for seven-year periods, with a maximum of two such funding cycles being available.

For the 2005 competition, 31 Letters of Intent were received and reviewed by the NCE Selection Committee. The Steering Committee then invited five groups to submit full applications by the deadline of April 5. The Selection Committee is currently evaluating the applications.

<b>NETWORK</b>	<b>SCIENTIFIC DIRECTOR</b>	<b>HOST INSTITUTION</b>
AllerGen (Allergy, Genes and Environment Network)	Judah Denburg	McMaster University
Canadian Child Welfare Research Network (CCWRNet)	Christine Wekerle	Centre for Addiction and Mental Health (CAMH)
Canadian Regenerative Medicine Network (CRM-Net)	Michael Sefton	University of Toronto
Cognitive Impairment Network (CI-NET)	Howard Chertkow	McGill University
Microsystems and NanoScience Network for Health and the Environment: Microsystems Interfaces Canada	Linda Pilarski	University of Alberta



## THE YEAR'S HIGHLIGHTS

*Renewing the commitment to excellence*

Every network receives a funding commitment of seven years, with a maximum NCE life span of two seven-year cycles. At the mid-point of the seven-year cycle, the networks undergo an evaluation process to ensure they are meeting their goals. At the end of their first seven-year cycle, networks can apply to renew funding for a second term.

In 2003-2004, four networks underwent renewal:

- The **Canadian Arthritis Network (CAN)** is a not-for-profit organization dedicated to creating a world free of arthritis through integrated, trans-disciplinary research and development. CAN links 120 leading Canadian arthritis researchers and clinicians, 40 Canadian academic institutions, The Arthritis Society, pharmaceutical and biotechnology companies, and government.
- The **Canadian Institute for Photonic Innovations (CIPI)** brings university researchers together with public sector and industrial partners in a network with state-of-the-art facilities to stimulate innovations in photonics – the science and technology of generating, manipulating, transmitting and detecting light.
- The **Geomatics for Informed Decisions (GEOIDE)** network catalyzes the research and development of geomatics – the science of gathering, analyzing, managing, distributing and using geographic information – by contributing to the creation of strategic alliances between the academic, governmental and industrial
- The **Mathematics of Information Technology and Complex Systems (MITACS)** network leads Canada's effort in the generation, application and commercialization of new mathematical tools and methodologies. The network initiates and fosters links with industrial, governmental, and not-for-profit organizations that require mathematical technologies to deal with problems of strategic importance to Canada.





THE YEAR'S HIGHLIGHTS

*Moving through the funding cycles*

Throughout the life cycle of each network, funding allocations are reviewed and revised. The Steering Committee awards grants to new networks based on the recommendations of the Selection Committee, while existing networks are reviewed at

regular periods during their funding cycles to ensure they are meeting NCE program objectives. Networks leaving the program can apply for Research Management Funding to help them make the transition to sustainability.

OVERVIEW OF NETWORKS' FUNDING CYCLES

Network	Cohort	2003-04	2004-05	2005-06	2006-07	2007-08	2008-09	2009-10	2010-11	2011-12	2012-13	2013-14	2014-15	2015-16	2016-17	2017-18	2017-19
AFMNet	2003				MT			RC									
AQUANET	1999			RC				MT			RMF						
ArcticNet	2003				MT			RC				MT					
AUTO21	2000		MT			RC				MT			RMF				
CAN	1997		RC				MT			RMF							
CANVAC	1999			RC				MT			RMF						
CBDN	1989		RMF														
CGDN	1989		RMF														
CIPI	1997		RC				MT			RMF							
CLLRNet	2000		MT			RC				MT			RMF				
CSN	1999			RC				MT			RMF						
CWN	2000		MT			RC				MT			RMF				
GEOIDE	1997		RC				MT			RMF							
IRIS	1989		RMF														
ISIS	1994			MT			RMF										
Micronet	1989		RMF														
MITACS	1997		RC				MT			RMF							
PENCE	1989		RMF														
SCN	2000		MT			RC				MT			RMF				
SFM	1994			MT			RMF										

- 1st funding cycle
- 2nd funding cycle
- RMF Funding
- Future funding if successful in mid-term review and/or competition for last funding cycle

- RC Renewal Competition
- MT Mid-term review
- RMF Research Management Fund Competition



## THE YEAR'S HIGHLIGHTS

*Coming together to create the future*

*"Canada has developed a series of networks that are the envy of the international academic and scientific community. I hear it when I travel abroad: scientists, researchers and administrators all ask me for the secret. How has Canada been so successful in drawing together our academic and research strengths?"*

**Dr. Martha Piper**

President, University of  
British Columbia

The dual themes of impact and persistence dominated the discussions when scientific leaders, network managers and the Chairs of the Boards of Directors gathered at the NCE Annual Meeting in Vancouver last December. Throughout the sessions, the future – planning for it, embracing it – was always top of mind.

Dr. Tom Brzustowski, Chair of the NCE Steering Committee, said the successes achieved over the past 15 years have established the NCE as a national institution of innovation. Going forward, he would like to see more networks and "new groupings of research talent to address emerging issues as well as emerging opportunities for Canada." He spoke of the NCE meeting the challenges of the future by producing "the greatest possible amount of positive qualitative change."

Dr. Martha Piper, President of the University of British Columbia, also looked to the future when she delivered the keynote address at the conference and spoke on the theme "Where to from here?" She suggested it will soon be time for NCEs to "go international" by connecting with the great research centres of the world and emphasized the need to enhance technology transfer by aggressively commercializing research discoveries.

The annual meeting gives network managers and scientific leaders from across Canada the opportunity to exchange ideas on everything from administering their networks to spinning-off start-up companies, licensing technology and handling intellectual property. It also gives industry leaders a chance to describe how their interaction with the NCE helped improve processes in bringing products to market. The Vancouver sessions included presentations by Irving Paper of New Brunswick on the business case for partnering with the NCE, and British Columbia-based Ballard Power Systems, which has successfully partnered with MITACS in the development of fuel-cell batteries.



## BENEFITS

*How NCE investment pays off*

### Benefits

The Networks of Centres of Excellence work to make positive economic and social impacts across the country. Some networks' efforts pay off immediately. For example, work done last spring to raise literacy levels is helping early childhood educators in day-care centres across Canada today. Others are committed to basic research that will pay dividends down the road, such as stem cell investigation. While some forge strong bonds with industry to bring new products and processes to the marketplace, others work in cooperation with government. All, either directly or indirectly, have the potential to improve the lives of Canadians.

### Benefits for Canadians

From fish farming to forestry management, from studying the Arctic melt to making automotive innovations, the work of the NCEs affects the lives of Canadians today and will continue to do so in the future.

### Benefits for industry

To compete and excel in the global economy, Canadian businesses need access to the latest research. NCEs work in partnership to help companies improve their products and processes, allowing them to increase efficiency and cost-effectiveness.



### Benefits for government

Research undertaken by the NCEs helps federal and provincial government stakeholders make informed decisions affecting their populations and to develop policy for the future.

### Benefits for research

First-rate research fuels economic progress. Through its much-admired networking model, the NCE program attracts and retains world-class researchers to work in state-of-the-art research facilities to produce outstanding results.

### Investing in networks

The NCE invests in national research networks that will:

- Stimulate leading-edge research in areas critical to economic and social development;
- Develop and retain world-class researchers in areas essential to Canada's productivity;
- Create nationwide multidisciplinary and multisectoral research partnerships; and
- Accelerate the exchange of research results within the networks and the use of these results by organizations that can harness them for economic and social development.

### A new model for research

The NCE removes barriers that separate university research, industrial exploitation and the public use of research results. There is a high degree of networking and collaboration among researchers who also build partnerships with industry and/or government.

### Managing outcomes

Every year, the NCEs report on their activities and achievements in all areas, including excellence of research, the extent of their collaborations, the knowledge they have created and transferred to users, and the people they have trained and retained. These data are collected and reported globally for the overall program in each annual report.



## THE NETWORKS

*Twenty networks crisscross the country*

There are 20 NCEs across Canada working in fields as diverse as automobile engineering, photonics, genetics and mathematics. Researchers are studying everything from the social and economic effects of climate change in the Arctic, to fighting deadly diseases by developing better vaccines.

### **Advanced Foods and Materials Network (AFMNet)**

A gourmet feast of collaboration: Multidisciplinary approach advances food and bio-materials research.

### **AquaNet (Network in Aquaculture)**

Getting the facts on sea lice: Canadian and Norwegian scientists break new ground in aquaculture research.

### **ArcticNet**

Fieldwork begins in Nunavik: Canada launches the most comprehensive study ever done of Inuit health.

### **AUTO21 (The Automobile of the 21<sup>st</sup> Century)**

Helping vehicles avoid crashes: What previous studies haven't revealed about anti-lock brake systems.

**Canadian Arthritis Network (CAN)**

Commercialization under way: Glucosamine derivative shows promise for arthritis sufferers.

**Canadian Bacterial Diseases Network (CBDN)**

Good news for humans: Canadian-developed vaccine reduces *E. coli* in cattle.

**Canadian Genetic Diseases Network (CGDN)**

Bridging the gap from lab to bedside: Clinical trials for new cancer drug started with early support from CGDN.

**Canadian Institute for Photonic Innovations (CIPI)**

New treatment in sight for leading cause of blindness: Using the precision of lasers to focus on single cells.

**Canadian Language and Literacy Research Network**

Practical ideas for everyday child care: Classroom calendar breaks speed records for putting research results into practice.

**CANVAC – Canadian Network for Vaccines and Immunotherapeutics**

A “potent” new research tool: State-of-the-art lab to advance research into vaccines and immunotherapies.

**Canadian Stroke Network (CSN)**

Advances in basic science: Preventing stroke damage starts with understanding cell death.

**Canadian Water Network (CWN)**

Crossing the scientific divide: New alliances are identifying water problems before they happen.

**Geomatics for Informed Decisions Network (GEOIDE)**

Marine safety: Researchers develop life-saving tool for search and rescue missions.

**Institute for Robotics and Intelligent Systems (IRIS)**

From outer space to underwater: Shrimp-like creature takes Canadian robotics to new depths.

**Intelligent Sensing for Innovative Structures (ISIS Canada)**

When bridges talk: A winnipeg firm is taking ISIS technology to world stage.

**MITACS – Mathematics of Information Technology and Complex Systems**

The science of predictions: Alberta researcher transform random data into practical knowledge.

**Micronet – Microelectronic Devices, Circuits and Systems**

Tracking moving objects: Calgary start-up to deliver new healthcare safety system.

**PENCE Inc. (Protein Engineering Network)**

Closing in on a drug candidate: Pence researchers tackle the SARS virus from all sides.

**Stem Cell Network (SCN)**

Discovery: Closing in on a cure for juvenile diabetes.

**Sustainable Forest Management Network (SFM)**

North American sales top 1,400: Network’s encyclopedic reference book on sustainable forest management “not just for academics”



THE NETWORKS  
*Networks at a Glance*

SUMMARY OF THE 20 NETWORKS — 2003-2004

Networks	Funding Period	NCE Award	Network researchers*	HQP**	Universities***	Industries***	Government departments/ agencies and others***	Total organizations
AFMNet	2003 - 2010	\$2,110,000	n/a	n/a	24	8	4	36
AQUANET	1999 - 2006	\$3,600,000	50	160	34	33	37	104
ArcticNet	2003 - 2010	\$2,444,000	n/a	n/a	3	6	4	13
AUTO21	2000 - 2008	\$5,077,000	245	368	41	77	44	162
CAN	1998 - 2012	\$3,480,000	124	454	28	51	60	139
CANVAC	1999 - 2006	\$4,700,000	72	174	23	44	74	141
CBDN	1989 - 2005	\$3,787,000	305	189	48	27	46	121
CGDN	1989 - 2007	\$4,590,000	43	389	11	34	77	122
CIPI	1999 - 2012	\$3,231,000	98	197	29	41	18	88
CLLRNet	2000 - 2008	\$3,118,000	115	135	35	10	58	103
CSN	1999 - 2006	\$4,700,000	61	283	25	18	45	88
CWN	2000 - 2008	\$3,273,000	105	61	34	37	72	143
GEOIDE	1998 - 2012	\$2,960,000	137	257	66	93	59	218
IRIS	1989 - 2006	\$4,457,000	104	225	25	113	24	162
ISIS	1995 - 2009	\$3,200,000	98	215	15	53	20	88
Micronet	1989 - 2005	\$2,267,000	78	402	22	84	17	123
MITACS	1998 - 2012	\$3,582,000	131	465	37	113	61	211
PENCE	1989 - 2005	\$4,795,000	80	129	16	61	30	107
SFM	2000 - 2008	\$4,640,000	63	522	32	26	46	104
SCN	1995 - 2009	\$4,100,000	156	265	35	31	33	99
<b>Totals</b>		<b>\$74,300,000</b>	<b>2065</b>	<b>4888</b>	<b>589</b>	<b>968</b>	<b>831</b>	<b>2388</b>

\* Network researchers include Canadians and foreigners  
 \* two networks in first year of operation have yet to fund researchers  
 \*\* - HQP: means Highly Qualified Personnel including research staff (research associates and technicians) and research trainees (postdoctoral fellows, graduate and undergraduate students)  
 \*\*\* including Canadian and foreign organizations  
 \*\*\* Organizations are counted for each appearance, ie. If an organization participates in multiple networks, they will be counted more than once.



Yada (AFMNet)

## ADVANCED FOODS AND MATERIALS NETWORK (AFMNET)

*A gourmet feast of collaboration***Multidisciplinary approach advances food and bio-materials research**

*Like expert chefs who contribute their best dish to a buffet dinner, bringing together the individuals and organizations that make up the Advanced Foods and Materials Network could have created a mishmash of disparate skills that would never gel. Instead, AFMNet is a smorgasbord of diverse expertise and knowledge – a gourmet feast of ideas, input, and cooperation that is advancing food and bio-materials research in Canada.*

AFMNet is one of the newest Networks of Centres of Excellence (NCE). Its members include food and bio-materials researchers in all areas, plus experts in law, ethics, risk assessment and management, business, societal issues, nutrition, health, economics, and policy. It's a unique combination of expertise.

Dr. Rickey Yada at the University of Guelph is the Network's scientific director and a driving force behind its creation. Over the past decade, he has had several opportunities to participate in multidisciplinary councils and panels on food and biotechnology research that included different combinations of these disciplines. These gatherings were eye-opening experiences for him. He saw, first-hand, the incredible potential of this approach.

"The wisdom of bringing these people together was quite forward-thinking," he says. "Biotechnology is not just a science issue, there are ethical and societal issues and an atmosphere of necessary caution around food and bio-materials research. So it's really important to have social sciences involved in a science issue right from the beginning."

**AFMNet Research Themes**

*AFMNet has three broad strategic themes: the structure, dynamics, and function of foods and bio-materials; functional foods and nutraceuticals; and economics, environment, and societal issues (i.e. regulations and consumer attitudes and perceptions). To qualify for Network funding, each research project must address at least two of these three themes.*

*"The main criterion is that it can only be research that can be done by a network," says Dr. Rickey Yada, AFMNet's Scientific Director. "It can't just be more of the same of what you're doing, because then why would you need the Network?"*

*The Network's 49 current research projects are grouped within six key research areas: bio-surfaces, bio-structures and bio-products, extraction and identification, mechanism and efficacy, consumer and citizen acceptance, and regulations and policy. However, because of their multidisciplinary approach, many of these projects include elements and expertise reflected in multiple themes.*

The successful creation of AFMNet reflects the strong commitment of its members to a multidisciplinary approach and an appreciation for the direct and necessary link between food research and society at large.

AFMNet's application to the NCE program was unique. "Our strategy was that we had no preconceived strategy for specific projects. We said that we were going to gather



the best people we could, bring them together face-to-face, and then decide on research areas we thought were critical. These were areas where, as individuals, we didn't have a lot of expertise, but collective expertise could help us solve that problem."

Their approach was successful. "It showed us the beauty of pulling people together – the best people you could – to work on a single problem or a group of problems."

The people who collectively make up AFMNet are located in nearly every region of the country. While adding to the diversity of knowledge and areas of expertise, this can make communication and working together unwieldy and problematic. As Dr. Yada says, "There's nothing like being able to run across the hall to borrow a cup of sugar." Since that wasn't possible, they had to put extra effort into communication. And again they took a unique approach.

One of the key mandates of the NCE system is training the next generation of researchers. "It's vital," says Dr. Allan Paulson, AFMNet's Associate Scientific Director. "They're going to be the educators and researchers of tomorrow. They'll start businesses or create policy and regulations. We see their training as one of our key deliverables."

With a focus on multidisciplinary research, it's important for the trainees to see and experience all components of a project. First-hand is the best way to gain that experience, and, as Dr. Paulson points out, one of the best ways to improve communication within a group is to have people move around.

"That's not so easy for the professors, the research scientists, and the people in industry. But we have trainees, post-docs, graduates, etc., who can. We have them move from lab to lab and not just within the universities. They also go to government or industry labs. It keeps everybody up on what's going on and it gives them a unique multidisciplinary training that is going to be to their benefit."

When seeking network status, AFMNet turned to other networks for advice and guidance to see what had worked well for them and what hadn't. "The *network* of the networks works really well too," Dr. Yada explains. "When we went through this process, we had wonderful words of wisdom from other NCEs. They were more than willing to help us out."

While AFMNet is just getting starting, Drs. Yada and Paulson are firm believers in the effectiveness of the network model for advancing research. "I think the Canadian scenario of research networks allows us to do more comprehensive research," says Dr. Yada. "It's amazing what the return on the dollar is. Canadians do great science."

[www.afmnet.ca](http://www.afmnet.ca)



AQUANET (NETWORK IN AQUACULTURE)  
*Getting the Facts on Sea Lice*

**Canadian and Norwegian scientists break new ground in aquaculture research**

*A tiny parasite that occurs naturally on salmon is the focus of a transatlantic research project that could have significant economic implications for Canada's wild and farmed fish industries.*

Dr. Scott McKinley doesn't believe in spending millions of taxpayer dollars, or shutting down industries, to remedy a problem that isn't supported by scientific evidence. Rather, the Executive Scientific Director of Canada's AquaNet Network of Centres of Excellence (NCE) is using his long-standing connections with world-renowned researchers in Norway to determine if sea lice from farmed salmon are infecting wild salmon, if other factors are at play, or whether the perceived problem is simply a "red herring."

In Canada, concerns over sea lice forced 11 of 27 Atlantic salmon farms in British Columbia to close during the migration of pink salmon in 2003 (a practice called "fallowing").

"The controversy over sea lice from farmed fish infecting wild fish is based on correlations. There is no study published showing a cause-and-effect relationship," says Dr. McKinley, an environmental physiologist and Senior Canada Research Chair at the University of British Columbia. "We cannot ask industry to spend millions of dollars on fallowing certain areas or using chemical treatments unless you have substantiated proof that there is a problem."

That's why university researchers and graduate students from Canada and Norway have joined forces in the most ambitious international study ever undertaken by an NCE.

In February 2003, Aquanet and Fiskeriforskning, a world-class Norwegian aquaculture research institute, signed a three-year agreement to exchange scientists

**AquaNet joins EU seafood project**

*AquaNet is the only non-European partner participating in the world's largest aquaculture project. With funding of 23.3 million euros from the European Union, the SEAFOODplus program includes participation from 70 partners from 16 European countries and Canada.*

*Starting in 2004, AquaNet will work with partners in Norway, the U.K., France, Spain, and other countries on research related to nutrition and husbandry. The Canadian team will help to develop non-invasive tagging technology for fish to study the effects of husbandry and aquaculture systems on seafood quality.*

*Dr. Scott McKinley, the Executive Scientific Director of AquaNet, credits Canada's involvement in this project to the Network's strong research ties to the Fiskeriforskning research institute in Norway.*

*"We're the only non-European state listed as a partner, so this is quite a coup for us, the NCE, and ultimately Canada," he says.*

and work collaboratively on topics of common interest, with an emphasis on sea lice and the interaction between wild and farmed fish. The collaboration represents a significant investment by AquaNet, but the return on investment is tenfold.

When Dr. McKinley joined Aquanet as a researcher in 1999, he not only brought his years of experience in sustainable management of fish stocks, he also brought a long list of distinguished contacts from his years of working in Norway – a country that employs more than 20,000 people in aquaculture and is an international leader in this growing sector.

*"Within a year we're going to have scientifically based data on the risk of farmed fish contributing to sea lice in wild fish. That's going to tell us that we have to do more work in terms of where we place farms, how we treat fish, or it's going to tell us that this big scare has been nothing but a red herring."*

**Dr. Scott McKinley**  
 Executive Scientific Director  
 Aquanet



“Having worked in Norway for over a dozen years, I was very familiar with the scientists and the research institutions there,” he says. It was the NCE program, he adds, that provided a mechanism for the two countries to network their respective expertise.

Norway is recognized internationally for its expertise in understanding the risk posed by sea lice to fish stocks and the development and evaluation of mitigative strategies. With specialties in biochemistry and telemetry, the Canadian team hopes to develop a cause-and-effect tool, called a stable isotope signature, that could show a link between sea lice on fish farms and in the wild, if one exists.

“Using a wireless communications devices, we can track fish when they leave the river, determine how fast they are swimming, what direction they’re heading and whether they are hanging around fish farms,” he explains. “We can use that information to determine an overall risk management model for outmigrating smolts.

Once the data have been compiled, peer-reviewed and published, Canada and Norway will work on designing science-based strategies to mitigate the impact of sea lice on salmon stocks. The joint research could also lead to licensing agreements and other commercial opportunities from the collaboration for both countries.

The collaboration with Norway is attracting interest among other European countries, including Denmark, the Netherlands, Spain, and Italy – all of which are interested in the NCE’s approach to developing a multidisciplinary, national research network.

“We have also talked to the Food and Agricultural Organisation of the United Nations,” adds Dr. McKinley. “That could well be our next collaboration, which would bring Canada’s expertise in aquaculture to developing countries.”

[www.aquanet.ca](http://www.aquanet.ca)





Dewailly (ArcticNet)

ARCTICNET

*Fieldwork begins in Nunavik*

**Canada launches the most comprehensive study ever done of Inuit health**

*Is the health of Canada's Inuit people deteriorating? Is climate change a factor?*

*These are among the many questions being studied by ArcticNet researchers as part of the largest health survey ever undertaken of northern residents.*

It was a first for Canada's scientific community, and a first for Canadians living in one of the most remote regions of the country.

On August 28, 2004, a multidisciplinary team of doctors, nurses, and scientists left Churchill, Manitoba, aboard Canada's first dedicated research icebreaker. The CCGS *Amundsen* sailed east across Hudson Bay to the coastal town of Kuujuaapik in northern Quebec – the first of 14 Nunavik communities they would visit during their month-long expedition.

ArcticNet researchers are among those participating in the largest health survey of Inuit ever undertaken anywhere. The cross-sectional Inuit Health Survey is examining the overall health of about one thousand randomly selected Nunavik residents, including lifestyle, diet, heart disease, bone density, safety habits, and exposure to environmental contaminants. It will also detect more urgent health problems, such as diabetes or osteoporosis.

The study might never have happened without participation from ArcticNet, one of Canada's newest Networks of Centres of Excellence.

"Sending people to the North to do this type of study is very complex and very expensive," says Dr. Éric Dewailly, an epidemiologist with the Quebec Centre for Public Health at Université Laval and the Principal Investigator of the survey. "By piggybacking various studies together,

**Canada to lead international study**

*ArcticNet is leading an initiative with colleagues in Greenland, Alaska, and Siberia to develop an international longitudinal study that would assess the impacts of dietary and environmental changes on cardiovascular disease, cancer, and diabetes in Inuit populations around the world.*

*"The idea of doing a public health study that includes medical services and core research aboard the Amundsen could be used as a model for an international core study in these other circumpolar regions," says Dr. Éric Dewailly, the ArcticNet researcher leading the Canadian Inuit Health Study.*

including ArcticNet's, a large-scale study like this becomes cost-effective. No single group could have done this on their own."

ArcticNet is contributing two key components to the study: three complementary research projects, and funds to operate the retrofitted Canadian Coast Guard icebreaker that can reach these remote communities. The *Amundsen* is a floating laboratory and medical clinic, providing all the equipment needed by nurses, doctors, and researchers to conduct comprehensive tests on northern residents, as well as the surrounding physical environment.

The *Amundsen* is the primary research platform for the 145 Canadian and international scientists and students participating in the new \$25.7-million ArcticNet research consortium, which is studying the natural, medical, and societal effects of climate change in Canada's Arctic regions.

With enough room for 45 researchers and 36 crew, the ship also provides a training ground for dozens of graduate students and local Inuit assisting with the various studies.



"This is the first time this type of research vessel has been used to carry out a health study of Inuit," says Dr. Dewailly. "In addition to the research, we are also able to provide medical services, like breast cancer screening, which isn't available in these communities."

The voyage represents the first field studies for ArcticNet health specialists. One project is examining changes in dietary patterns and the emergence of chronic disease, while another is looking at drinking water contamination. A third project is tracking brucellosis and 11 other zoonotic diseases that can be transmitted from animals to humans. The studies will be repeated in 2006 with Inuit living on Baffin Island in Nunavut.

These three health projects are part of a wider, highly integrated ensemble of 26 Arctic projects that form the scientific program of ArcticNet to study the environmental, health, and socio-economic impacts of the ongoing meltdown of the Arctic. Earlier in the summer, ArcticNet oceanographers sailed on the *Amundsen* in the Beaufort Sea and on the Russian icebreaker *Kapitan Dranytsin* in the Laptev Sea (Siberia) to deploy long-term observatories of the changing coastal Arctic Ocean. Social scientists supported by ArcticNet have also initiated a major consultation of Inuit communities on climate change and its impacts.

Data compiled from a smaller health study of the Nunavik Inuit in 1992 resulted in a ban on lead shot ammunition, as well as programs to reduce mercury exposure among pregnant women, prevent iron deficiency, and reduce smoking. Dr. Dewailly says this Nunavik survey will be used to develop similar health prevention and promotion programs.

"If you just rely on health statistics, like mortality or hospitalization, you're too late," he stresses. "This study is significant because we are going to healthy people and measuring the beginning of abnormalities. The opportunity to change and modify screening, health promotion, and health prevention will be far more efficient than waiting until it's too late."

[www.arcticnet.ulaval.ca](http://www.arcticnet.ulaval.ca)



AUTO21 – THE AUTOMOBILE OF THE 21<sup>ST</sup> CENTURY  
*Helping Vehicles Avoid Crashes*

**What previous studies haven't revealed about anti-lock brake systems**

*Groundbreaking Canadian research into side-impact crashes is revealing human, environmental, and engineering factors that can help drivers avoid vehicle collisions.*

What's the best way to avoid injury in a car accident? Don't crash.

A diverse group of AUTO21 researchers is transforming this commonsense advice into practical information that will help vehicle designers, city planners, and drivers reduce the risk of vehicle collisions, particularly side-impact crashes.

"The simplest and best way to avoid injury in crashes is to avoid the crash in the first place," says Prof. Mary Chipman, the principal investigator on the four-year project, which wraps up in March 2005. "Sometimes you have to remind people of that very obvious fact, because they get caught up in research that looks at what happens when a crash occurs. Lab tests are very good for determining how doors should be designed to withstand certain impacts, but they can't tell you very much about what you need to do and what the vehicle needs to have to avoid crashes."

Prof. Chipman is a professor of epidemiology and biostatistics at the University of Toronto's Department of Public Health Sciences and an expert in applying statistics to the medical sciences. She is currently working with a cross-Canada team of engineers and epidemiologists to examine all aspects of side-impact crashes, including the design of vehicle doors, seats, and street fixtures.

For her part, Prof. Chipman is analyzing detailed Transport Canada data from crash investigations to determine what safety features reduce the likelihood of a side-impact crash.

*"The solution of any traffic crash is an interaction between the driver and the vehicle and the surrounding environment. No one scientific discipline can come up with a solution. That's the real strength of AUTO21. They are aggressively multidisciplinary when it comes to finding and implementing solutions. It was during one of the first meetings to discuss the NCE program that I became aware of the various scientific disciplines involved in auto-related research. I thought I was pretty well connected across Canada, but these were people I had never met before. It was very sobering to learn how isolated we had all been. We didn't even realize it."*

**Prof. Mary Chipman**  
 Department of Public Health Sciences  
 University of Toronto

**Investigators**

- Prof. Mary Chipman (Principal Investigator, University of Toronto)*
- Dr. Michel Gou (École Polytechnique)*
- Dr. Claire Laberge-Nadeau (Université de Montréal)*
- Dr. Bhagwant Persaud (Ryerson University)*
- Dr. Parminder Raina (UBC)*
- Dr. Douglas Romilly (UBC)*
- Dr. Khaled Sennah (Ryerson University)*
- Dr. Reza Vaziri (UBC)*

**Partners**

- Transport Canada*
- Société d'assurance automobile de Québec (SAAQ)*
- Insurance Corporation of British Columbia (ICBC)*
- Centre for Research in Transportation (CRT)*
- Insurance Bureau of Canada (IBC)*

Side-impact crashes account for 25% to 40% of all collisions, resulting in significant injury and even death. Yet, compared with frontal crashes, little is known about their epidemiology or biomechanics.

The project team analyzed data from crash investigations conducted in Toronto and Montreal on side-impact crashes involving a "bullet" (striking vehicle) and a "target" (struck vehicle). Data included the make, model, year, curb weight, dimensions, and safety equipment such as airbags, anti-lock brake systems (ABS), and traction control on vehicles involved in the accident.

Researchers reviewed 26 side-impact crashes in Toronto, involving both the target and the bullet. They also compiled information on nearly 200 control vehicles – vehicles that



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passed by the crash site close to the crash date, on the same day of the week and time of day. In Montreal, the team reviewed 35 side-impact crashes, collecting data on about 300 control vehicles.

The AUTO21 project is the first definitive study to examine if anti-lock brake systems can help drivers avoid a side-impact collision. Some previous studies concluded that ABS were effective, but in limited circumstances. Other studies found that crashes were more common in vehicles with ABS, suggesting that drivers with ABS drove differently.

The most striking revelation from Prof. Chipman's research so far is that ABS can help the striking vehicle avoid a side-impact crash.

"ABS doesn't decrease the stopping distance, but it does reduce the risk of skidding," she explains. "If the brakes lock and there's something in front of you, you lose control and may not be able to steer to avoid the crash."

The findings could persuade regulators to make ABS a standard feature in vehicles, rather than an optional extra. Prof. Chipman says it could also influence the future design of automobiles, and help insurance companies identify lower-risk clients.

Preliminary results from the research were presented last year at the U.S.-based Society for Automotive Engineers International, which is considering an additional five papers on related subjects from this study for its 2005 conference.

*[www.auto21.ca](http://www.auto21.ca)*



CANADIAN ARTHRITIS NETWORK (CAN)

## *Commercialization under way*

### **Glucosamine derivative shows promise for arthritis sufferers**

*Arthritis can be extremely debilitating, especially for otherwise healthy and active individuals. An effective treatment can help them maintain the quality of life they enjoyed before the disease slowed them down.*

For years, people with osteoarthritis, a very common degenerative disease of ageing populations, have taken the popular over-the-counter supplement glucosamine. This is because glucosamine, a chemically simple sugar with a nitrogen atom, is an important component of the supporting structure of joint cartilage.

The rationale behind taking the supplement is that if you provide one of the building blocks, perhaps you can help regenerate or repair the cartilage. It's so popular, the market is estimated to be in the billions of dollars.

Published studies into the effectiveness of taking glucosamine (usually in the form of glucosamine sulfate, a salt of glucosamine) have indicated that there is improvement in pain scores in osteoarthritis sufferers. However, not all studies support this and the use of glucosamine for osteoarthritis is still under active investigation.

Because of glucosamine's popularity and potential, scientists and doctors who specialize in osteoarthritis have long felt that the compound warranted a closer look. One of the research goals was to discover if, by modifying the chemistry of glucosamine, its properties could be enhanced.

Dr. Tassos Anastassiades, a researcher with the Canadian Arthritis Network (CAN), recently discovered and patented a glucosamine derivative called Anabu™ that does have different properties from glucosamine. "It's expected that this derivative will have advantages over the parent glucosamine," he says. That's great news for those who suffer from the pain and stiffness of arthritis.

*Glucosamine is a naturally occurring and very prevalent compound. There are small amounts in the hard tissues of the human body, where it is an important building block of the complex carbohydrates that make up the extra-cellular matrix of cartilage. In arthritis and other rheumatic diseases, cartilage degenerates and key molecules built from glucosamine are lost.*

*However, there are some deficiencies with this form of glucosamine, cautions Dr. Anastassiades. "Glucosamine is metabolized very rapidly, so in terms of over-the-counter glucosamine, very little probably reaches your joints as free glucosamine." In addition, while some studies show that in certain concentrations it seems to inhibit cell death, in other concentrations it seems to inhibit cartilage cell growth. So it's a complex picture. On the other hand, glucosamine is non-toxic and can be used safely.*

*The source material for over-the-counter glucosamine is chitin – a very abundant polymer in the animal kingdom – from the shells of lobster and crab.*

"We've taken the starting material, pure glucosamine, and then chemically modified it. Specifically, the modification is on the nitrogen atom of the sugar. This is the same atom that is naturally modified by humans and other species, before glucosamine becomes part of the structure of the cartilage of joints," explains Dr. Anastassiades, who is based at Queen's University in Kingston.

"What we observed is that when we do these chemical modifications, we come up with a class of compounds whose properties are quite different from the parent compound. In particular, we don't find some of the inhibitory effects that we see with higher concentrations" (see sidebar).



### CAN expertise advances commercialization

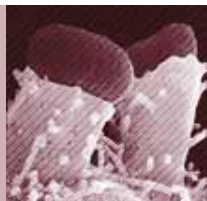
With the support of CAN, Dr. Anastassiades has patented Anabu™ and the Network is leading the licensing and commercialization process. He's enthusiastic about what they've accomplished together. "It's CAN's most advanced project from a commercialization point of view, I believe. We have licensed the technology to a veterinary company and we are looking, again through CAN, to licensing it for humans. Several pharmaceutical firms have expressed an ongoing interest."

"The Network is tailor-made to do this kind of thing. They offer an opportunity to work with the researcher and advance these kinds of compounds in development before you seek a partnership with a biotechnology or pharmaceutical company. The Networks of Centres of Excellence play a very important role by providing a much-needed addition in terms of technology transfer in Canada."

Anabu™ will likely be available for the veterinary market within a couple of years. It is hoped that, not too long after that, it will complete the rigorous testing and approval procedures required for human use and be available to arthritis sufferers.

[www.arthritisnetwork.ca](http://www.arthritisnetwork.ca)





## CANADIAN BACTERIAL DISEASES NETWORK (CBDN)

*Good news for humans***Canadian-developed vaccine reduces *E. coli* in cattle**

Canadians know first-hand the dangers of *E. coli* infection and the devastation an outbreak can cause. In May 2000, in the small town of Walkerton, Ontario, seven people died and more than 2,000 became ill when runoff from nearby cattle operations contaminated the town's drinking water supply. More recent outbreaks in Calgary, Sudbury, and the Maritimes and frequent occurrences in the USA highlight the broad impact of the threat to human health.

Doctors Brett Finlay and Andrew Potter, researchers with the Canadian Bacterial Diseases Network (CBDN), have developed a vaccine that reduces the chance of humans being exposed to the same dangerous strain of *E. coli* that has hit Walkerton and other communities across Canada. The vaccine significantly reduces shedding of the *Escherichia coli* 0157:H7 bacterium in cattle.

Creating a vaccine for cattle to deal with a human health issue may seem a little odd. But because the primary source of human infection is cattle, "An *E. coli* vaccine for cattle is the best solution, because it deals with the problem at the source," says Dr. Finlay. The vaccine is in the final stages of testing and approval and should be commercially available in the near future.

Developing this vaccine and working toward commercialization has been a team effort from the beginning. Dr. Finlay, who comes at the problem from a human health perspective, teamed up with Dr. Andrew Potter, the Associate Director (Research) of the Vaccine and Infectious Disease Organization (VIDO). He is also a member of CBDN. Dr. Potter's area of expertise is animal health and vaccine development.

**How it works**

*E. coli* 0157:H7 was discovered in 1975. A relatively new strain of the bacterium, it's a powerful toxin in humans. While it can affect the health of young calves, it's harmless in older animals. Dr. Finlay made the initial critical discovery that led to the creation of this vaccine. He determined how this strain of *E. coli* attaches itself to intestinal cells. The vaccine works by preventing this attachment. Without it, the bacteria can't multiply and create more bacteria.

Early studies confirmed the proof-of-concept, and recent large-scale controlled-challenge field studies show the vaccine to be very effective in achieving its goal – to reduce the amount of *E. coli* shed by cattle in their manure. In the latest tests, there was a 99.56 percent reduction in the amount of bacteria shed and a 70 percent reduction in the number of animals that shed bacteria.

"It was a natural fit," he says. He credits CBDN with providing them with the framework to work together. "Without CBDN there to act as a catalyst, it never would have started, plain and simple."

While the Walkerton tragedy certainly brought the *E. coli* problem to public light, research into ways to prevent human infection was well under way before that event. The Alberta Research Council (ARC) of Edmonton and Bioniche Life Sciences Inc., a human and animal health biopharmaceutical company located in Belleville, Ontario, were involved almost from the beginning. In 1999, Dr. Dragan Rogan, Vice-President of Research and Development in Bioniche's





Animal Health Division, reviewed some data generated by Doctors Potter and Finlay. "I felt that it was promising and that there was a real opportunity here," he says. He contacted CBDN and ARC and that's how it started.

The business and market expertise provided by Bioniche to the researchers was vital. "It's very important with products of this type to make sure that there is a commercial pathway identified up front," says Dr. Potter. "Having private sector input into the process is invaluable. We can still do good science, but with their help, we can do it in a way that is compatible with commercial development."

Because of their upfront support, Bioniche can look forward to reaping economic benefits by manufacturing and marketing an effective product.

By working together, the transfer of this technology from the lab to market has been swift and effective. In fact, all of the partners in the project strongly believe that this team approach streamlined the process and compressed the usual timeline of developing and getting this kind of product to market. It's a simple equation.

"We were able to do certain things simultaneously," says Martin Warmelink, President of Bioniche's Food Safety Division. "For example, the licensing and regulatory work was done at the same time as the scale-of-manufacturing work, by different parties within the partnership. When we complete this in four to five years, I'd say we will have achieved a record for this kind of product."

Working under the umbrella of CBDN had additional benefits. The Network helped connect the multiple areas of research expertise needed to create a product like this. It also provided researchers with a framework that allowed them to concentrate on the science and not worry about some of the other issues.

"For example, intellectual property issues can sometimes get in the way of doing research, especially if you have more than one institution involved," Dr. Potter explains. "In our case, we had a single institution, CBDN, dealing with that."

Training the next generation of research scientists and biotech workers has been a major part of CBDN's work over the past 15 years. Dr. Potter believes that students, with opportunities created by being part of the Network, gain an insight into the way the world works.

"They do excellent science, but as part of a network, they have that translational viewpoint to the real world." For him, talent development is one of the most positive aspects of the network model. "I'm actually collaborating with former students of CBDN members. That's three generations within that 15-year span. It's absolutely phenomenal."

[www.cbdn.ca](http://www.cbdn.ca)



CANADIAN GENETIC DISEASES NETWORK (CGDN)  
*Bridging the gap from lab to bedside*

**Clinical trials for new cancer drug started with early support from CGDN**

*They call it the "Valley of Death" – that high-risk stage when a "discovery" moves from the laboratory, to the patent office, to clinical trials, and finally to patients. CGDN is providing critical support that is helping start-ups navigate this rocky road.*

Aegera Therapeutics Inc. is a rising star on the global biotechnology scene. With \$20 million in new funding, the Montreal start-up launched Phase 1 clinical trials in March 2004 of a new drug candidate that could prolong the lives of cancer patients with advanced tumours.

It's a promising new therapeutic that might never have left the lab without some critical funding and management support from the Canadian Genetic Diseases Network (CGDN).

Aegera is commercializing technology developed by Drs. Robert Korneluk and Alex MacKenzie of the Children's Hospital of Eastern Ontario. The two geneticists, with ongoing CGDN support, identified a family of genes that is responsible for programmed cell death, or apoptosis, in humans. This fundamental research is fuelling Aegera's efforts to develop therapeutics that kill cancer cells by inducing apoptosis, rescue neurons from cell death, and implant stem cells to restore function.

The initial discoveries were promising, but far too early in the development pipeline to attract serious interest from venture capitalists. Investors want to see much more than an innovative idea or even a discovery. They want protected intellectual property, a strong management team, and a clearly defined target market.

**CGDN helps bring "the pill" to men**

*Dr. Grant Mitchell wasn't looking to develop a contraceptive pill for men. Since 1990, his CGDN-supported research focused on pediatric genetic diseases characterized by an inability to metabolize fat in the normal way. Unexpectedly, Dr. Mitchell discovered that a gene known to play an important role in fat metabolism also plays a critical role in the development of sperm.*

*RecepTide Pharmaceuticals Inc., a new Vancouver start-up company, is now building on that research to develop a non-hormonal male contraceptive pill.*

*CGDN has been involved since the beginning. It helped Dr. Mitchell and his colleagues at l'Hôpital Sainte-Justine in Montreal in filing a patent. CGDN also awarded Dr. Mitchell \$60,000 from its Strategic Grant program to develop a test (assay) that would enable the identification of synthetic compounds that could be used as a male pill.*

*Next, CGDN formed RecepTide to further develop the technology. It then assembled a who's who from the Canadian life sciences community to bring credibility to the young company. They include former CGDN board member Dr. Mark Pearson, a renowned medical geneticist who started his career at the University of Toronto and has launched two major biotech start-up companies.*

*CGDN also brought aboard Dr. Robert Sindelar, the dean of pharmaceutical sciences at the University of British Columbia, and Ed Levy, former senior executive with the biotechnology company QLT Inc.*

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*"Aegera is one of the most promising private biotechnology companies in Canada today. They have successfully made the transition from the research bench to the clinic and have the management depth, intellectual property, and drug candidates to rapidly develop into a leading North American biotechnology company."*

**Luc Marengere**  
 General Partner  
 VenGrowth Advanced  
 Life Sciences Fund

“Research funding usually dries up once a discovery is made,” explains Dr. Ron Woznow, CEO of CGDN. “So what do you do? You need money to do the additional experiments to strengthen your intellectual property. This is a black hole that exists within the commercialization process.”

CGDN moved aggressively to deal with this gap in 1994 with the launch of its Strategic Grant program, the first program of its kind in Canada. Drs. Korneluk and MacKenzie were among the beneficiaries, receiving \$50,000 to do the additional research required for proof-of-principle and the protection of patent claims. CGDN also leveraged its contacts in the Canadian life sciences community to assemble a high-profile interim management team, help secure start-up capital, and launch a new company to study the therapeutic potential of apoptosis control.

In addition, CGDN made its national network of core research facilities available to Drs. Korneluk and MacKenzie. “If CGDN members are in a race to protect a patent, these researchers can get preferential treatment for the use of our core facilities across the country,” says Dr. Woznow.

Apoptogen Inc. was launched in 1995 with \$8.5 million in seed funding provided by CDP Capital-Technology Ventures, Canadian Medical Discoveries Fund, Neuroscience Partners Limited Partnership, and Working Ventures Canadian Fund. In 2000, Apoptogen merged with Exogen Neurosciences to become Aegera. CGDN continues to hold equity in the company.

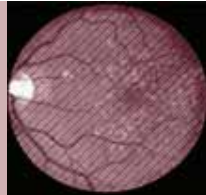
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*“CGDN uses its track record, its network, and its credibility to help companies during the early stages of their development,” says Dr. Ron Woznow, CEO of CGDN. “We now have three key people on ReceptTide’s board who can pick up the phone and venture capitalists are going to listen to their story.”*

CGDN has garnered an impressive track record for commercializing genetic discoveries. The \$800,000 awarded through its Strategic Grant program has led to the creation of six new biotechnology companies, including Aegera, Xenon Pharmaceuticals Inc., SignalGene Inc., and NeuroVir Therapeutics (acquired by MediGene). These spinoffs in turn have raised more than \$135 million in investments and generated more than 900 jobs.

“Now that Aegera is in clinical trials,” Dr. Woznow adds, “it validates the CGDN Strategic Grant program goal of catalyzing the translation of genetic discoveries into new treatments and cures.”

[www.cgdn.ca](http://www.cgdn.ca)



CANADIAN INSTITUTE FOR PHOTONIC INNOVATIONS (CIPI)

## *New treatment in sight for leading cause of blindness*

### **Using the precision of lasers to focus on single cells**

*A CIPI team is developing an instrument to prevent the collateral damage that frequently destroys healthy retinal tissue during treatment of the leading cause of blindness.*

Age-related macular degeneration – the leading cause of blindness in most developed countries – occurs when tissue and blood vessels in the centre of the retina grow too rapidly.

The current treatment of choice is photodynamic therapy (PDT). Patients are given a light-sensitive drug that is taken up only by the damaged tissue. Therapists then selectively irradiate the area with light that energizes the drug to destroy the unhealthy tissue.

Although this treatment halts the disease's progress, explains CIPI team leader Dr. David Cramb, it seldom allows for recovery of lost sight. "The inability to restore sight," says Dr. Cramb, "may be due to collateral damage to surrounding healthy tissue." But such damage could be minimized, even eliminated, he says, if therapists could focus the treatment more precisely.

By "more precisely," the University of Calgary professor is talking about focusing on areas as minute as an individual cell. "To treat only the unhealthy tissue," he explains, "we need to use light that will pass harmlessly through all the healthy tissue, but will enter the cells that have been identified by the light-sensitive drug. That would enable us to eliminate the collateral damage, creating a better chance for sight to be recovered."

### ***Biophotonics: New light on medical applications***

*Photons are subatomic particles of light. Like atoms, they have energy and momentum; unlike atoms, however, they have no mass or electric charge.*

*Photonics is the technology of light: how to produce it, detect it, manipulate it, amplify it, and analyze it. Photons have properties such as colour, polarization, and directionality that offer us invaluable opportunities for probing and energizing materials with extraordinary finesse. The technical world is just beginning to tap into this complexity.*

*Biophotonics – the application of photonic science and technology to life sciences – is rapidly emerging as a new field. Already it ranges from medical applications such as optical diagnostics, light-based therapies, and minimally invasive patient monitoring to advanced tools for biology, biotechnology, environmental monitoring, and detecting pathogens for such applications as fighting bioterrorism.*

*Researchers in the Canadian Institute for Photonic Innovations (CIPI) are focusing much of their efforts on biotechnology, engineering, and life sciences applications that complement other significant Canadian photonics organizations, such as Photonics Research Ontario, the Canadian Light Source in Saskatchewan, and the Advanced Laser Light Source in Quebec.*

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A process of advanced photonics – two-photon absorption – provides the basis for a new version of photodynamic therapy. If two photons must be simultaneously absorbed to excite the drug, then sensitivity to the light intensity is greatly increased. Only at the focal point of a highly focused laser beam will the drug be energized sufficiently to destroy the damaged cell, leaving all healthy surrounding tissue untouched.

By adapting ultrafast laser technology to current ophthalmoscopes, Dr. Cramb's multi-disciplinary team, working out of six universities (McGill, Waterloo, Sherbrooke, McMaster, Toronto, and Dr. Cramb's own labs at the University of Calgary), are bringing their collective expertise to create ways of delivering light with sufficient control and precision to deliver two-photon PDT. The goal is to build a prototype "point and shoot" instrument that ophthalmologists can use in their offices.

How soon before the project moves "from bench top to bedside"? Within the next four years, the team expects to meet such challenges as developing lasers less expensive than those used in the prototype; enabling the light-sensitive drugs to handle the new two-photon technology; circumventing a patient's eye movements during retina scans; and making the optical system adaptive to correct for optical aberrations in the lens or cornea of the patient's eye.

The team expects to complete work on the prototype point-and-shoot version within two years. Working with collaborators in the biological and medical sciences, as well as the pharmaceutical industry, within four years they expect that animal tests will have yielded the data needed to conduct clinical trials with humans and to support commercialization of the technology.

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*In addition to the Two-Photon Excitation Photodynamic Therapy project described here, CIPI researchers at universities and institutions throughout Canada are collaborating with researchers in other biological or biomedical sciences, as well as with interested pharmaceutical and technological companies on several other major biophotonics projects.*

*These include:*

- *Projects with the potential to provide breakthrough technologies for analyzing single molecules within a cell – relevant to many biotechnology applications, including drug discovery.*
- *Micro-imaging projects with specific applications for neuroscience and projects that will exploit the properties of light to image genetic micro arrays and molecular pathology tissues.*

*CIPI's biophotonics work involves collaborations not only within the Canadian science community, but with photonics researchers around the world. For example, CIPI researchers have established linkages with the National Science Foundation's new Center for Biophotonics Science and Technology at the University of California at Davis, the Laser Laboratorium in Goettingen, Germany, the Israel Institute of Technology, and Cornell University.*

*International industrial linkages include collaboration with Hamburg, Germany's Evotech, which will support development of single-cell handling systems; the American firm Hysitron, for collaboration on probes of atomic forces; the American firm Rasiris, which will provide new*

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As for commercialization, Dr. Cramb reports that several companies well known for ophthalmology instruments are already interested. Right now, the titanium sapphire laser that the CIPI team is working with costs approximately \$150,000. Dr. Cramb

foresees reducing that cost to approximately \$20,000 – a price that would enable physicians to equip their offices with an instrument for on-site treatment.

[www.cipi.ulaval.ca](http://www.cipi.ulaval.ca)

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*light-sensitive test drugs for CIPI's two-photon photodynamic therapy project; and anticipated support from the U.S. National Institutes of Health for the clinical-trials phase of the two-photon photodynamic therapy project.*





CANADIAN LANGUAGE AND LITERACY RESEARCH NETWORK (CLLRNET)  
*Practical Ideas for Everyday Child Care*

**Classroom calendar breaks speed records for putting research results into practice**

*Why wait a decade or longer for good science to reach the classroom? Canadian experts have found an ingenious way to do it in two years.*

Starting in September 2004, teachers and early childhood educators from across Canada are using an innovative and entertaining new calendar designed to strengthen language and literacy skills among preschool children.

"Thousands of young children spend most of their waking hours in child care," explains Elaine Weitzman, Executive Director of The Hanen Centre, one of the main partners in the calendar project. "That's why it's critical that the people caring for these children know how to help them develop optimal language, social, and literacy skills. This calendar gives caregivers the tools to prepare children for the social interactions and academic learning they will require later in life."

The 16-month calendar (beginning September 2004) translates cutting-edge research findings into fun, practical activities for childcare professionals to use in the classroom or in small groups. Developed by Ms. Weitzman and staff at The Hanen Centre and by Dr. Luigi Girolametto, a professor at the University of Toronto's Graduate Department of Speech-Language Pathology, the calendar was launched by the Canadian Language and Literacy Research Network in partnership with these two organizations.

Each week, the calendar features tips and techniques in both English and French that encourage educators to engage children in conversation and foster greater peer interaction. In October, for example, it

**Literacy increases GDP**

*Investment in human capital, such as education and skills training, is three times as important to economic growth over the long run as investment in physical capital, according to a June 2004 Statistics Canada study.*

*The analysis, based on data for 14 OECD economies between 1960 and 1995, found that a 1% increase in average skills could yield a permanent 1.5% increase in GDP per capita. For Canada, that would equate to an ongoing annual GDP jump of \$18.4 million.*

Source: Statistics Canada  
[www.statcan.ca/Daily/English/040622/d040622d.htm](http://www.statcan.ca/Daily/English/040622/d040622d.htm)

recommends that educators "have conversations with children while they are engaged in an activity." In August, it suggests that children be encouraged "to tell you personal stories." It also promotes linguistic and cultural diversity.

This practical advice draws upon nearly a decade of comprehensive research on language facilitation in childcare settings that top experts from Canada and the United States shared at an October 2002 symposium sponsored by the Canadian Language and Literacy Research Network. The proceedings from the symposium set the stage for development of the calendar.

"Journal articles are great for a scientific audience, but they don't address the practical needs of preschool teachers," says Dr. Girolametto. "We're dealing with childcare professionals who have little time for curriculum planning and may have no access to the Internet at work. The calendar seemed like a very practical way to disseminate research findings."

*"The calendar is very attractive, informative, and reflective of our multicultural population. First Word Preschool Speech and Language Program of Ottawa works in collaboration with the childcare community. It is our pleasure to disseminate this wonderful tool."*

**Sonia Rowe,**  
 Project Coordinator,  
 Ottawa, ON

*"Congratulations on a useful, highly relevant tool for caregivers!"*

**Karin Macaulay,**  
 Centennial Daycare,  
 Victoria, BC

*"We love it so much that we need more!"*

Ekwaamjigenang Children's Centre, Hagersville, ON

*"What a wonderful teaching tool! Great tips, easy to understand words, colourful graphics, diversity, inclusion – it's all there!"*

**Lynn Milligan**  
Childcare coordinator  
Gagetown Military Family Resource Centre,  
Oromocto, NB

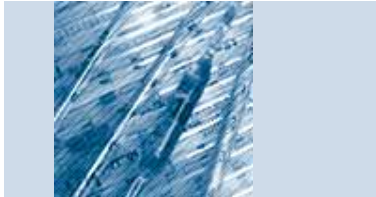
Often, it can take up to 10 years for peer-reviewed scientific papers and conference proceedings to be adopted by frontline childcare educators, clinicians, and teachers. Dr. Girolametto says they wanted to produce something that educators could begin using immediately in a real-world setting. The calendar also lists Web links for educators wanting more details on activities or the research itself.

"For example, a tip for one week suggests educators read a wordless book to the children," says Ms. Weitzman, whose centre provides training to speech language pathologists around the world. "If they go to The Hanen Centre's Web site, we have a link that provides additional ideas, such as examples of wordless books that we think would work well. It turns the calendar into a living resource."

Already, 30,000 copies of the calendar have been distributed to early childhood educators and speech language pathologists across Canada, with another 15,000 copies downloaded from the Network's Web site ([www.cllrnet.ca](http://www.cllrnet.ca)) – making it the largest target audience reached to date by the Network. Demand has been so high that the Network is reprinting another 5,000 copies. An updated version is planned for 2006, as well as an impact study to measure the calendar's effectiveness with caregivers.

"If you can train one educator, you can potentially reach thousands of children who will eventually go through the educator's classroom," says Ms. Weitzman. "By getting these research findings into practice quickly, we're reaching a whole generation of children who might otherwise not have had the advantage of being exposed to this kind of enriched environment."

[www.cllrnet.ca](http://www.cllrnet.ca)



CANVAC – CANADIAN NETWORK FOR VACCINES AND IMMUNOTHERAPEUTICS  
*A “potent” new research tool*

**State-of-the-art lab to advance research into vaccines and immunotherapies**

*HIV and AIDS, hepatitis C, and cancer are devastating diseases that affect millions of people throughout the world every year. Starting in 2005, a new state-of-the-art laboratory in Montreal will help advance the efforts of researchers who are working on new vaccines and immunotherapies that may bring hope to those people’s lives.*

The Canadian Network for Vaccines and Immunotherapeutics (CANVAC) is pioneering the concept of a centralized, national, core facility to monitor and analyze the immune status of patients at various stages of a disease and monitor their immune response to current vaccines and immunotherapies. It will be unique in the world.

CANVAC recognized the need for the new laboratory and the Université de Montréal, which hosts CANVAC along with other universities of the Network, applied for funding to the Canada Foundation for Innovation, which supports the creation of infrastructure for scientific research. Funding for the facility was announced early in 2004.

Dr. Michel Klein, Chief Executive Officer of CANVAC and a leading proponent of the facility, explains why it’s so important. “We currently lack the understanding of why certain people are protected against certain diseases, why others are not, and why a vaccine works or doesn’t work. We just don’t know. So unless we investigate these aspects with sophisticated tools and leading-edge technologies, we will not learn how to progress.”

A centralized laboratory will also harmonize data in standardized, validated, and consistent ways. In the past, there have been variations from one laboratory to another.

**A key piece of the puzzle**

*Why are some people protected against disease, while others are not?*

*CANVAC’s new laboratory will be well-equipped to find the answer, thanks to state-of-the-art technology. This technology will enable researchers to analyze all samples in identical conditions – regardless of where they originate.*

*For example, researchers will be able to compare the immune status and response of HIV/AIDS patients who have reached different stages of their disease: those with HIV infection without AIDS, those who progress rapidly to AIDS, those who don’t progress to AIDS, and those who remain seronegative. By examining where the immune response differs, researchers will learn more about the factors that correlate with progression or non-progression of the disease.*

*Their findings will be key factors in developing vaccines and immunotherapies and in determining their effectiveness.*

“We realized that, depending on the laboratory, the results of the assays can be different,” says Dr. Klein. “That’s because the people, technologies, and methods of analysis are different. Centralization and automation eliminate that source of error.”

This means that researchers can compare vaccines and therapies in an apples-to-apples way. All other things being equal, the results can confidently be considered accurate. “It’s a very potent research tool,” adds Dr. Klein.

Fully automated using robotic technology, the capacity of the new laboratory – the number of tests and volume of data it can handle – is tremendous. It's designed for high throughput to meet an equally high demand. And it will do this while adhering to good laboratory practices (GLP). "This is a very important consideration," says Dr. Klein. "Automation is much better than humans at complying with regulatory guidelines. It eliminates human error and ensures that we can reproduce results."

Specially created technologies, both software and hardware, including the robotic automation, will be developed in Canada by the University Health Network of Toronto and companies such as Becton Dickinson and the Canadian company Thermo CRS. However, while created in Canada by Canadians, the benefits of the facility are really to the world. "CANVAC has a mandate to transfer this technology to developing countries," says Dr. Klein. "The goal is to make sure that we use the same technologies all over the world."

Training highly qualified personnel is a vital component of the NCE program. The new laboratory will provide an incredible learning opportunity for students, who will be involved in actual research projects and clinical trials rather than the more theoretical work of academia.

"This real-world experience is extremely valuable," says Dr. Klein. "Very few students in the university are exposed to this kind of opportunity." The immune monitoring centre will train highly qualified scientists interested in working in a regulated scientific environment to "good laboratory practices" and to the rigour of quality control that is standard in industry settings.

The new laboratory will conduct tests from Phase I to Phase III clinical trials, in other words from safety to efficacy trials. The current areas of investigation are HIV, hepatitis C, and cancer, but that's just the start.

"If we show that as a proof-of-concept, the immune monitoring approach yields very important results, then this will be apply to many other diseases. That would mean an expansion, obviously," says Dr. Klein.

That expansion and broadening of the areas of investigation is one of their key goals. "These fields are never static," says Dr. Klein. "We always need to look further ahead. So while this platform is state-of-the-art today, there will be a component of the research to bring on new tests or more specific assays to look at different aspects of the immune response, in a dynamic situation. It's a continuum of progress."

Work on installing the laboratory will begin in early January 2005 and take approximately six months. So by mid-2005, the laboratory will start performing tests, and it should reach full capacity by the end of next year.

[www.canvac.ca](http://www.canvac.ca)





## CANADIAN STROKE NETWORK (CSN)

*Advances in basic science***Preventing stroke damage starts with understanding cell death**

*"If you don't understand why something happens, you can't fix it. We believe that basic research to understand brain cell death is the way to prevent stroke damage."*

*Dr. Michael Tymianski,  
Toronto Western Hospital*

A team of Canadian Stroke Network (CSN) researchers has discovered a major and previously unreported mechanism behind brain cell death in stroke.

The findings represent a huge shift in science's understanding of why strokes kill brain cells, says CSN investigator Dr. Michael Tymianski, a neurosurgeon at Toronto Western Hospital. In late 2003, the findings were published in *Cell*, the world's leading biological journal. Senior co-author on the paper was Dr. John MacDonald of the University of Toronto.

"If you don't understand why something happens, you can't fix it," Dr. Tymianski says. "We believe that basic research to understand brain cell death is the way to prevent stroke damage."

The team's theory is that when a stroke occurs and brain cells are deprived of oxygen, a special channel on the surface of those cells is activated. When activated, this channel – called TRPM7 – causes brain cells to produce large numbers of free radicals. Free radicals are caustic chemicals that break down a cell's DNA, proteins, and other components. Production of the free radicals ignites a lethal chain reaction.

If a drug could be produced that would interrupt that process, the impact of stroke could be significantly reduced.

Dr. Tymianski believes developing such a drug is possible, adding that medicine already knows there is a window of time

**Top young talent choosing stroke research**

*The Canadian Stroke Network is helping to attract some of Canada's top young minds to stroke research. Through its Focus on Stroke program, the CSN is supporting 45 university trainees from across Canada, in partnership with the Heart and Stroke Foundation, the Institute of Circulatory and Respiratory Health, AstraZeneca, and CIHR's Rx&D.*

*Celebrated as one of the country's leading training and partnership initiatives, Focus on Stroke has led to the development of a single application for research funding – a substantial national improvement in the review process.*

*"The benefits of being a CSN trainee are many," says Barbara Murdoch, a doctoral student in experimental medicine at the University of British Columbia. "Receiving scholarship funding for my doctoral studies not only helps to build my confidence as a young researcher in training, it allows me to devote more time to my research, and to present my data at international conferences, discussing its merits and weaknesses."*

*Ms. Murdoch is studying neurons in the olfactory system to examine how they are continually replaced by dividing stem cells. These preliminary studies lay the foundation for the examination of the utility of olfactory neuronal stem cells in the recovery from stroke.*

*"Through my training with the CSN, I anticipate forming collaborative scientific efforts to forge ahead in stroke research, with the ultimate hope of making the lives of stroke survivors better. For me, being a CSN trainee is a privilege that comes with the responsibility of utilizing and contributing to its resources, so all of us perform to our best. Obviously, being a CSN trainee is of priceless value."*



during which therapies can be effective. It has already been shown that clot-busting drugs, if administered within about three hours of a stroke, can limit stroke damage.

Dr. Tymianski and colleagues have created a company, called NoNO Inc., which will investigate the development of new therapies. NoNO, which stands for no nitric oxide – the agent that mediates cell damage – has received start-up funding from the Canadian Stroke Network.

“The CSN has been instrumental in bringing top researchers together to fight stroke,” Dr. Tymianski says.

Other members of the CSN team studying brain cell death include Dr. Yu Tian Wang (Brain Research Centre, University of British Columbia); Dr. James Gurd (biochemistry researcher, University of Toronto); Dr. Michael Salter (Canada Research Chair in Neuroplasticity and Pain, University of Toronto); and Dr. Richard Tasker (Atlantic Veterinary College, University of Prince Edward Island).

Stroke is the fourth leading cause of death in Canada, claiming about 16,000 lives each year. The Heart and Stroke Foundation estimates that between 40,000 and 50,000 strokes occur each year in Canada and about 300,000 Canadians are living with the effects of stroke.

[www.canadianstrokenetwork.ca](http://www.canadianstrokenetwork.ca)





## CANADIAN WATER NETWORK (CWN)

*Crossing the scientific divide***New alliances are identifying water problems before they happen**

*At the University of British Columbia, an ecosystem scientist and a public health expert are breaking new ground in interdisciplinary research to develop an early warning system for water contamination.*

They call it the "silo mentality" – researchers from different scientific disciplines working in isolation, unaware of the human, social, and economic benefits of pooling their collective expertise.

When it comes to the environment, human health, and safe drinking water, a silo mentality can have deadly consequences.

That's why, with the help of the Canadian Water Network (CWN), a diverse team of watershed experts, chemists, microbiologists, and civil engineers are pioneering a 21st-century approach to research that tracks the quality of drinking water from its source to your tap.

Dr. Hans Schreier, a professor at the University of British Columbia's Institute for Resources, Environment & Sustainability, and Dr. Judy Isaac-Renton, Director of the B.C. Centre for Disease Control Laboratory Services, are collaborating on three separate research projects that could help to prevent a future Walkerton-type tragedy from occurring.

Just four years ago, the veteran water experts had never heard of each other.

"Prior to the formation of the CWN, we were working in our own silos," says Dr. Isaac-Renton, a microbiologist with extensive experience in waterborne pathogens and their effects on human health. "I thought I was well connected, yet here were Hans and I living in the same city for 25 years and working for the same university, and never knowing we had a similar professional interest."

**Taking water surveillance online**

*Dr. Hans Schreier and Dr. Judy Isaac-Renton are working with the City of Chilliwack on a second Canadian Water Network project to field test fluorescent spectrophometers. Developed by Joule Microsystems Canada Inc. of Delta, B.C., these sensors measure pollutants in a river or stream.*

*The researchers are particularly interested in what happens to water after a "turbidity event" (i.e. heavy rainstorm), when bacterial runoff into rivers increases the risk of contamination. The equipment can take samples "at the flick of a switch," providing immediate test results for researchers, public health officials, and municipalities.*

*"From working with Judy, I'm learning that most serious health events occur after a turbidity event," says Dr. Schreier. "If we can measure these events beforehand, we can alert people to not use the water, to boil it, or wait until the turbidity is down again. This data is now available on the Internet for anyone to look up on a real-time basis."*

*Dr. Isaac-Renton says such an approach could dramatically change how drinking water is monitored.*

*"I think the type of public surveillance we're doing for drinking water is inadequate. It's far too late in the system," she says. "Right now, we spend millions of dollars to test water, not for public health purposes, but for managing the control, the filtration, the disinfection. The paradigm has to change and collaborations such as between Hans and myself, funded by agencies such as the Canadian Water Network, may help."*



Dr. Isaac-Renton describes their partnership as a natural fit: "Hans represents the source, and I represent the tap. By partnering we've covered off the flow of water from one into the other, with the goal of protecting public health."

Dr. Isaac-Renton's laboratory traditionally tested water at the end of the pipe to determine if it is safe for human consumption. Dr. Schreier has worked primarily in the field, using chemistry and remote-sensing GIS (Geographic Information Systems) to study the interaction between land use and water pollution.

As collaborators, they are sharing research results to identify sources of contamination before the water ever reaches the tap. For graduate students, it means a more holistic approach to water research. For example, one of Dr. Schreier's PhD students (Jamie Ross) is learning about microbial techniques in Dr. Isaac-Renton's lab, while one of her graduate students (Natalie Prystajacky) will join Dr. Schreier's team in the field as part of her study of bacteria in soil sediments.

"In terms of training for the future, the health component is being integrated into the scientific thinking that never was there before," says Dr. Isaac-Renton.

In one joint project sponsored by the CWN, the two researchers are examining how urban expansion and agriculture contribute to the spread of contaminants in the water system, the effects on human and aquatic health, and what can be done to manage or change this. The study, which wraps up in December 2004, is focusing on seven small watersheds in the Lower Fraser Valley – a community that has much in common with Walkerton, Ontario, including shallow wells, extensive livestock operations, and porous soil.

The project could result in a first-of-its-kind early warning system that identifies pollutants upstream, well before they reach the tap. The project would also identify sensitive areas that require a different approach to land management.

"Using GIS, we're measuring the chemistry and the bacterial conditions and also looking at the land use, so we can determine where these pathogens and nutrients are coming from," says Dr. Schreier.

This collaborative work with the CWN is creating opportunities for additional joint research. The Canadian Institutes of Health Research, for example, is supporting a \$852,000 three-year study looking at safe water through enhanced surveillance. Dr. Schreier and Dr. Isaac-Renton are among 20 researchers from across Canada participating in the project with Health Canada and Environment Canada. The goal is to work closely with municipalities to identify high-risk areas before contamination occurs.

"Our CWN project has opened the door for other projects that wouldn't have happened otherwise," says Dr. Isaac-Renton.

Dr. Schreier adds: "There are very few mechanisms in Canada that provide financial support for interdisciplinary research. That's why the Networks of Centres of Excellence is so critical, particularly when it comes to safe drinking water."

[www.cwn-rce.ca](http://www.cwn-rce.ca)



GEOIDE – GEOMATICS FOR INFORMED DECISIONS  
**Marine Safety**

**Researchers develop life-saving tool for search and rescue missions**

*GEOIDE researchers at three universities are completing the most comprehensive database of Canadian marine activity ever attempted – all in the name of saving sailors’ lives.*

With no roads to follow, a ship at sea can go anywhere.

But when things go wrong and help is urgently needed, the Canadian Coast Guard must get there quickly and efficiently. Being ready – and in the right place – saves lives.

In an exhaustive four-year study, Dr. Ronald Pelot’s Dalhousie University team is working with University of New Brunswick and University of Victoria researchers to chart marine traffic – from ocean-crossing super-tankers to cove-hopping pleasure craft – to help the Canadian Coast Guard limit the loss of life at sea.

The goal is to provide the Canadian Coast Guard, a partner and major investor in the GEOIDE project called *Marine Activity Geomatics and Risk Analysis in the Coastal Zone*, with a comprehensive database of all marine activity and the computer tools to assess risk and estimate demand for future search and rescue operations. The Maritime Activity and Risk Investigation System, or MARIS, will be handed over to the Coast Guard next year. A working version of the system is already in place.

Creating the traffic database has been a huge task. It includes data on all shipping traffic that has arrived and departed from eastern Canada since 1988. That’s more than 10,000 trips a year.

“We are using the points of origin, their destinations and the points at which they report in,” says Dr. Pelot. “One of the main

**Student Contributions to Marine Safety**

*Graduate students are a critical component of GEOIDE research. In the Marine Activity Geomatics and Risk Analysis in the Coastal Zone project, they are helping their supervisors assess and identify potential risks to seafaring vessels. Here’s what three students are contributing:*

**Helen Wu**, a PhD candidate at Dalhousie University, is studying the impact of weather on incidents at sea, something that hasn’t been done on a large scale before. Under the supervision of Dr. Pelot, she is comparing weather patterns to vessel traffic patterns and incident patterns. Wu is a former GEOIDE Student Network Council member.

**Kevin Pegler**, a PhD student at the University of New Brunswick, and David Coleman, Dean of Engineering, are studying the use of selected satellite pictures to identify recreational craft, compare them with survey results, and extrapolate the amount of traffic. Pegler received a GEOIDE Network of Centres of Excellence Partners Research Scholarship in 2001.

**Cindy Marven**, a Master’s student at the University of Victoria, is working with geography professor Dr. Peter Keller, Dean of Social Sciences, to examine accident and traffic patterns on Canada’s west coast. Marven was awarded the Best Student Presentation at the GEOIDE Conference in May 2003.

features of this software is to use those periodic points to create feasible tracks. It took one person-year to do that.”



### From aquaculture to eco-tourism

And that was just shipping. The project is also tracking 10 years of commercial fishing operations in Atlantic Canada, as well as the St. Lawrence and the west coast. The raw data came from a variety of databases at Fisheries and Oceans Canada. "For the smaller boats, we simulate the traffic. We know the area they're in. We know when they left and when they came back, so we can simulate that," explains Dr. Pelot.

The database will include details on other types of seafaring traffic, such as ferries in Atlantic Canada, ships used for fish farming and whale-watching tours, and other commercial recreational traffic. For example, one survey found there are some 300 coastal eco-tour companies operating from the east coast to close to Quebec City. And as Dr. Pelot points out, recreational craft are a more difficult fleet to find.

"You can't map all of the waters of Canada to sample recreational boating because it's too expensive. Based on targeted sampling and surveys, however, we will be able to say, for example, 'This should be the frequency on a nice summer day,'" he says.

### If only ships used roads

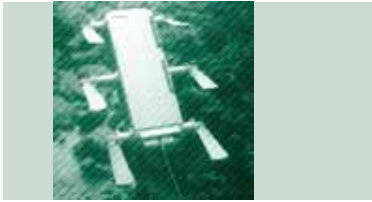
Creating a risk model is essential to predicting where accidents will happen. But it's a far trickier art form when the subject is ships at sea. Cars and trucks generally stick to the roads, making traffic patterns easy to measure. "There are many risk analyses of roads. They look at segments of roads or intersections. In risk analysis we use the term 'exposure,'" he explains. "Exposure is much better defined with roads, because the scope is well defined. You can set up traffic counters. There is nothing to keep fishing vessels or recreational boats from going anywhere they want."

There are many factors underlying accidents at sea. Dr. Pelot's team is looking at several variables such as the impact of the age of the vessel, the cargo it is carrying, trip length (the length of the trip within the Canadian area), the gross tonnage of the vessel, and weather patterns.

Dr. Pelot's research focuses on the "what" and the "where" of accidents at sea. "That's the mandate of our research. In the end, it will be good to know the "why" because then you can figure out what to do about it on the prevention side. Why do these things happen? We're getting there."

[www.geoide.ulaval.ca](http://www.geoide.ulaval.ca)





## INSTITUTE FOR ROBOTICS AND INTELLIGENT SYSTEMS (IRIS)

*From outer space to underwater***Shrimp-like creature takes Canadian robotics to new depths**

Canadian researchers have developed a three-eyed, six-legged robot that can walk, swim, and create 3D maps of coral reefs, oil platforms, underwater cables, or even sunken wrecks. There's no other technology like it.

It may look like a muffler with flippers and swim like a shrimp, but the high-tech gadgetry in the AQUA robot would make the Mars Rover green with envy.

A research team from McGill, York, and Dalhousie universities have combined computer vision and robotics technology to build the first robot that can walk into the water, swim to a specified area, build a three-dimensional model of what it sees, and then return to shore. AQUA (Autonomous Aquatic Walking Robot) could be used to inspect oil rigs, underwater cables, or changes to coral reefs or to search for sunken treasure. It can even remember shapes and familiar places.

The three-year, \$450,000 project, which wraps up in March 2005, is being sponsored by the Institute for Robotics and Intelligent Systems (IRIS) as well as the Canadian Space Agency (CSA) and MD Robotics of Brampton, Ontario.

"We're dealing with basic science questions related to vehicles with high degrees of mobility, which is why MD Robotics and CSA are interested," explains Project Leader Dr. Michael Jenkin, a computer scientist at York University. "In space or underwater, there is no plane and essentially zero gravity. As a result, you need a robot that works in a sixth-degree of freedom space. Very little is known on how to do this."

Most robots operate on a flat plane. Their hardware and software are not designed to

**Investigators**

**Martin Buehler** (on leave at BDI)

**Gregory Dudek** (McGill)

**Michael Jenkin** (York)

**Evangelos Milios** (Dalhousie)

**Project Staff**

**Chris Prahacs**, McGill: Design and construction of the hexapod robot

**Jim Zacher**, York: Development and deployment of the robot's trinocular stereo head

**Graduate Students**

**Christine Georgiades**, McGill (flipper design, simulator and dynamics)

**Eric Bourque**, McGill (modelling and infrastructure)

**Robert Sim**, University of British Columbia (formerly McGill) (vision-based localization)

**Paul DiMarco**, McGill (depth inference)

**Junead Sattar**, McGill (vision-based control)

**Andrew Hogue**, York (trinocular rig development, psychophysics and VR design)

**Arlene Ripsman**, York (motion path planning)

**Andrew German**, York (trinocular rig development)

**Pifu Zhang**, Dalhousie (acoustic localization)

move in three-positional and three-rotational degrees of freedom. AQUA's combined walking and swimming capabilities, along with sophisticated 3D-camera and modelling technologies, make it unique in the field of underwater robotics.

During its first test at the Bellairs Research Institute in Barbados in January 2004, AQUA proved it could swim, observe, and survive in an ocean environment. A second saltwater test is planned for January 2005.

Four faculty, along with 10 graduate students and two technicians, are each tackling a particular research question relating to sensing and reasoning, navigation, and locomotion underwater.

At McGill, Dr. Martin Buehler and Dr. Gregory Dudek modified a six-legged walking robot – called the Rugged RHex – to create AQUA. This included transforming the hexapod's six legs into six flippers that allow the robot to swim through water as well as waddle on the surface of an ocean floor.

Dr. Dudek is also working on the computer vision technology that allows AQUA to recognize where it is, and to build a three-dimensional picture of what it's looking at using a statistical learning-based model.

At Dalhousie University, Dr. Evangelos Milios developed a low-cost version of an acoustic localization system that permits an operator to accurately determine the robot's position underwater.

Meanwhile, researchers at York University are conducting experiments with a computerized camera system that uses three artificial eyes and an artificial balance system to obtain 3D models of an underwater scene.

Dr. Dudek, who heads the McGill Mobile Robotics Laboratory, says the project has been a great learning experience for graduate students.

"Because IRIS focuses on taking theory and putting it into practice, our students are learning how to take computer science ideas and make them work with physical things – wheels, gears, cameras. If you're going into industry, you have to know how to span that gap between theory and real applications."

While this phase of the project finishes in April 2005, the team plans to seek additional funding to move the technology closer to commercialization.

"One of the big things IRIS has done is it's given us a forum and an infrastructure within which we can approach various potential industrial partners," says Dr. Jenkin. "We're talking to some groups that may be interested in taking parts of the technology and spinning it off into more applied things."

Adds Dr. Dudek, "We already have a second version on the drawing board that would be cheaper, lighter, and better. I'm also working with a biologist who may be interested in using AQUA to assess changes and damage to coral reefs."

IRIS, a federally funded Network of Centres of Excellence, is managed by Precarn Incorporated, a not-for-profit national consortium of corporations, research institutes, and government partners supporting the development of robotics and intelligent systems.

[www.precarn.ca](http://www.precarn.ca)





## ISIS CANADA – INTELLIGENT SENSING FOR INNOVATIVE STRUCTURES

### *When bridges talk*

#### **A Winnipeg firm is taking ISIS technology to the world stage**

*A Winnipeg electronics company has designed and manufactured a durable, street-ready system that civil engineers can use to monitor the health of bridges, buildings, and other structures.*

University researchers are whizzes at making things work in the lab. However, they'll be the first to admit that making that same technology work in the "real world" is often beyond their expertise.

Such was the challenge for a team of ISIS Canada researchers who needed to replace a bulky computer monitoring system with a commercial product that can "see" inside structures and provide feedback on how ISIS-designed materials and components are functioning. The technology will help civil engineers to identify structural weaknesses in everything from bridges to planes, dams, pipelines, buildings, ships, and wind turbines.

ISIS found its solution in IDERS Inc., a small Winnipeg engineering company that designed the first debit card terminals for CIBC. The goal this time was to assemble advanced electronics, opto-photonics, semiconductor lasers and other sophisticated features into an easy-to-use interrogation unit. These high-tech boxes read information from "smart" sensors and chart it on a graph to show a structure's stress levels. Data can be viewed in real time on the ISIS Canada Web site at [www.isiscanada.com](http://www.isiscanada.com).

"We're talking about very sensitive electronics that have to survive in a metal box bolted to the side of a bridge with cars rumbling over it for decades," says David Fletcher, Vice-President of IDERS. "They saw a role for us to take this from the development phase right through to the finish line."

#### **NCE takes bite out of risk**

*David Fletcher admits commercializing research is risky, which is why the Networks of Centres of Excellence program is so critical. The Vice-President of IDERS Inc. says working with ISIS Canada made it feasible for his company to develop a new structural health monitoring system.*

*"When we took this project on there certainly were risky elements, and that's where Doug [Thomson] and his group at the university knocked the sharp edges off the research."*

*In addition to introducing IDERS to the burgeoning field of structural health monitoring, ISIS also worked with the company to test and validate the technology.*

*"Now that we're off on our own trying to market the results of this technology, we're finding that having worked with ISIS and having their stamp of approval is opening doors for us. Because ISIS is so renowned internationally, it brings credibility to our technology. We would never have been able to do this on our own."*

With additional financial assistance from the Industrial Research Assistance Program, IDERS delivered the first five commercial systems to ISIS this summer. They will be used on structures embedded with fibre Bragg grating (FBG) optical sensors developed by ISIS.

Developed by a team of 20 IDERS engineers, scientists, and technicians working alongside university researchers, the interrogation unit takes over 100 readings a second rather than the one per second ISIS was working with in the lab. It can be unplugged and moved to wherever it is needed, or permanently installed at a site.



"IDERS has developed something that is rugged enough to be put in the back of a pickup truck and used in the field," says Dr. Douglas Thomson, an ISIS researcher who began working on the project with IDERS in 2001. "It also has enough communications horsepower that it could be installed permanently at a site like the Confederation Bridge, transmitting the data back on a continuous basis."

Structural health monitoring systems are injecting a wealth of new information, new life and ideas into the design of urban structures and into the management and restoration of Canada's aging bridges and buildings.

In addition to being first off the mark with a commercial FBG system, IDERS has developed a product that has more features and a lower price than what competitors are developing. The 10-kilogram grey boxes cost \$25,000 to \$100,000, depending on the application.

Formed in 1991, IDERS employs about 30 people, mostly University of Manitoba engineering graduates. Just this year, it moved into the university's new Smartpark, a 30,000-square-foot building located on the campus.

For ISIS, the system represents a major step toward commercializing a sensing technology that its researchers have been working on for years.

"It's very rewarding as a researcher to see technology from a university be taken up by the private sector," says Dr. Thomson, a professor in the Electrical & Civil Engineering Department of the University of Manitoba. "I can't imagine that this technology would have been commercialized without the NCE. Their flexibility and goal-oriented approach really helps to facilitate these types of partnerships with the private sector."

[www.isiscanada.com](http://www.isiscanada.com)



MITACS – MATHEMATICS OF INFORMATION TECHNOLOGY AND COMPLEX SYSTEMS

*The science of predictions*

**Alberta researcher transforms random data into practical knowledge**

*The world is awash in data we cannot understand or use. A homegrown technology is now making sense of this seemingly random knowledge to detect computer hackers, personalize television commercials, or locate a missing ship at sea.*

Canada's growing expertise in applied mathematics could have major implications for national defence, network security, financial markets, and search and rescue. It may even alter the face of television.

Dr. Michael Kouritzin is a world-renowned expert in mathematical and statistical sciences at the University of Alberta. He is also the president of two new companies spun off from the university and MITACS that are bringing his novel statistical algorithms to large corporations like Lockheed Martin.

Dr. Kouritzin heads the Prediction in Interacting Systems (PINTS) – a MITACS-funded research centre formed in 1999 that is marrying mathematics, statistics, and computer science to determine what is going on in real life. PINTS has developed mathematical modelling and prediction techniques that take into account all the behaviour, characteristics, and conditions that affect how random systems operate and behave. It removes the guesswork and human error when it comes to tracking boats, aircraft, submarines, and other targets.

*"We've used the PINTS technology for some small contracts, and as part of our ongoing research. We're hopeful the technology will help Lockheed Martin win large contracts in the future."*

**Dr. Ron Mahler**  
Staff Scientist  
Lockheed Martin Naval Surveillance Systems

**MITACS-developed technology is helping an Edmonton company track performers around a stage.**

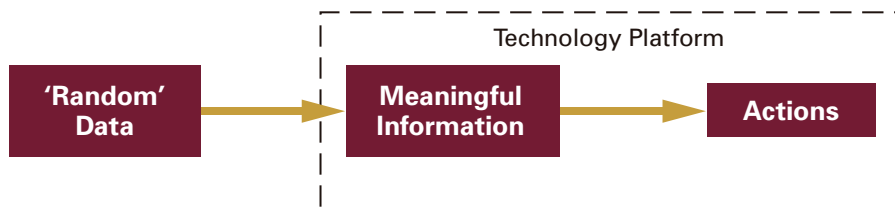
*Acoustic positioning research is combining robotics and mathematical filtering theories developed at the Prediction in Interacting Systems (PINTS) laboratory at the University of Alberta to design a virtual stagehand that keeps lights shined on a performer based on predictions of where the person will move.*

*A computer receives ultrasonic signals from a tracking device worn by a performer to track and control the stage lighting.*

"Imagine a dinghy lost at sea," explains Dr. Kouritzin. "A helicopter is trying to locate it based solely on noisy imagery taken from a digital camera, infrared, or radar. Our platform filters through this data and comes up with a statistical prediction on where the dinghy is located. This same mathematical filtering theory can be used to track computer hacking, money laundering, or even insider trading."

Lockheed Martin, the main corporate partner in PINTS, has filed three patents from the technology, two of which are being used in its current research.

"We're defence contractors, so we deal with military applications – trying to find the locations, speeds, velocities of non-cooperating platforms, such as an unfriendly jet air fighter, or missile," says Dr. Ron Mahler, a staff scientist at Lockheed Martin Naval Surveillance Systems in St. Paul, Minnesota. "To do this research, we need the type of technology that Mike has been developing."





Dr. Mahler describes the Canadian researcher as a pioneer in an area of applied research that has stymied engineers, mathematicians, and computer scientists for years.

"These technologies are definitely ahead of the game, so much so that our sponsorship of his work appears to have spurred a huge increase in interest in non-linear filtering," he adds. "Mike presented his first paper on this in 2000 (at the AeroSense-2000 Conference in Orlando, Florida), and since then, the number of papers in this technology area has increased exponentially."

Dr. Kouritzin is now actively marketing the technology through two spinoff companies, Fast Track Technologies and Random Knowledge. The first products are in the areas of network security, fraud detection, finance, and television.

One product, called DEFEND, is an intrusion detection and response system that finds, isolates, and destroys network intruders such as spyware. Random Knowledge is currently seeking venture capital funding to finalize development of a prototype.

Fast Track and Random Knowledge are also working with Invidi Technologies Corp. of Edmonton to develop a product that would use PINTS algorithms to detect and track the optimal viewing audience for specific commercials.

"The idea is to profile television viewers, so the right commercials can be played. Depending on your viewership profile, you might get a different commercial than your neighbour." Field tests are planned for early next year, with a commercial launch expected later in 2005.

One of the greatest challenges facing mathematics today is moving it out of the universities and into real-world applications. Dr. Kouritzin credits MITACS for making significant strides in this area.

"MITACS is playing an important role in getting the academic community to realize and exploit the industrial relevance of mathematics, and getting industry to realize how mathematics can be used to improve efficiencies, productivity, and profits. What we're doing now with Random Knowledge is just the beginning."

Simulations of the technology can be found on the PINTS Web site at [www.math.ualberta.ca/pints](http://www.math.ualberta.ca/pints).

[www.mitacs.ca](http://www.mitacs.ca)





## MICRONET- MICROELECTRONIC DEVICES, CIRCUITS AND SYSTEMS

### *Tracking Moving Objects*

#### **Calgary start-up to deliver new health-care safety system**

*Micronet support has helped a Calgary researcher develop a new technology – and launch a new company – that promises to improve patient care safety.*

A Calgary hospital could be the first to field test a first-of-its-kind “smart” camera that alerts nurses if a patient is about to fall from bed, or is en route for a medical test.

Developed by Dr. Wael Badawy at the University of Calgary, with funding assistance from Micronet and other partners, this low-cost technology uses multiple cameras and infra-red sensors to track and code video objects, such as people, vehicles, or other moving objects. The first application will include intelligent monitoring systems for hospitals to create an “Intelligent Patient Room.”

The technology has already produced two pending patents and one spinoff from the University of Calgary, Smart Camera Technologies Inc. The research behind the system spans more than six years, originating with Dr. Badawy’s PhD studies at the University of Louisiana.

“This technology goes much further than the video streaming technology currently on the market,” explains Dr. Badawy, Chief Technology Officer of the new company, and Associate Professor at the University of Calgary Department of Electrical and Computer Engineering. “Our camera system takes an image and produces intelligent data. With other systems the camera is a passive device, and a person has to view the image to determine what is in the scene.”

Founded in March 2003, Smart Camera has built its first prototype for the transportation sector. It is now finalizing development on a second prototype for healthcare applications,

with a commercial release expected within months. The company is making arrangements to manufacture the circuit boards in Calgary.

Like multiple computers connected to a distributed network, dozens or even hundreds of intelligent cameras can be linked over a wireless and wireline network to collect, interpret, and transmit data in real time. The system can find and track any moving object within the field of view of the camera, and generate data on trajectory and speed.

Support from Micronet helped to fine-tune the motion-tracking algorithms and architecture required to track and identify objects. Dr. Badawy also credits Micronet for advancing work on the hardware implementation for this technology.

The technology’s key advantages over existing systems are its low power consumption and low bit rates. The latter condenses the amount of video information being sent, making it possible to transmit multiple video streams over low-bandwidth wireless networks.

“With our technology, we can characterize the moving objects in real time, and we can program the system to take a particular action, such as alerting a nursing station to an incident with a patient,” he explains.

Another advantage to Dr. Badawy’s technology is that, unlike other systems, his cameras don’t require recalibration each time they change angles, or if they are jarred in a windstorm. “That gives our technology a real advantage in severe weather.”

In addition to video cameras, the technology can be used for infrared, ultrasonics and other specialized sensors.

Smart cameras developed with Micronet’s support could become part of the “Medical Ward of the 21<sup>st</sup> Century,” a new 36-bed teaching unit at Foothills Medical Centre in Calgary that is pilot testing new approaches to healthcare delivery, research, education and technology. The trial would enable Calgary-based Smart Camera Technologies to develop an in-field proof-of-concept, which would help to attract venture capital.

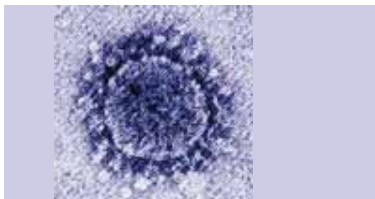
In the near term, the smart cameras could become part of the “Medical Ward of the 21<sup>st</sup> Century,” a new 36-bed teaching unit at Foothills Medical Centre in Calgary that is pilot testing new approaches to health-care delivery, research, education, and technology. The trial would enable Smart Camera Technologies to develop an in-field proof-of-concept, which would help to attract venture capital.

“In healthcare, we don’t see anybody else offering what we have, which is why the experts at Ward 21 are very interested in following up with this technology,” says Dr. Badawy. “We’re already talking about the potential for future projects – using this technology in rural hospitals, extended care facilities, or even for home care. Putting the system into a ward is just the first step.”

The smart camera system could also be installed on highways to count the number of vehicles on the road or identify the distance between cars and their relative speed – providing intelligent feedback on current traffic conditions. Police could potentially use the system to locate stolen vehicles.

[www.micronetrd.ca](http://www.micronetrd.ca)





## PENCE – PROTEIN ENGINEERING NETWORK

*Closing in on a drug candidate***PENCE researchers tackle the SARS virus from all sides**

*SARS (severe acute respiratory syndrome) became a part of our lives in the spring of 2003. Healthcare communities faced incredibly difficult and complex challenges as they tried to deal with this mysterious and new disease.*

The Canadian Protein Engineering Network, or PENCE, reacted quickly when the SARS epidemic took Toronto, and the world, by surprise. The Network rapidly mobilized \$300,000 in funding for research toward the identification of validated targets for therapeutics, as well as lead compounds and libraries of drug candidates.

“Our ability to quickly commit and deploy almost 10 percent of our annual research funding highlights how a pre-established network of researchers, such as PENCE, can rapidly respond to national emergencies,” says Dr. Stephen Withers, CEO and Scientific Director of PENCE. Within days of the announcement of the determination of the SARS genome sequence, PENCE researchers had begun work on key proteins. Within four weeks, a series of projects had been proposed, peer-reviewed, and funded. Some of these were in conjunction with the B.C. SARS Vaccine Initiative (SAVI).

Seed funds from PENCE have led to excellent progress toward the identification of potential lead drug candidates to treat SARS. Indeed, in just over a year, several papers have already been published, and several others submitted.

“The capacity for rapid sequencing of complete pathogen genomes has changed the face of research into the development of therapeutics and diagnostics for these diseases. With the sequence information in hand, research can start immediately in standard labs without the need for containment facilities,” says Dr. Withers.

**SARS Web site has information for researchers and the public**

*Early in the fight to characterize the virus and find effective therapies for SARS, PENCE recognized the need to have an effective and efficient way to disseminate the ever-increasing information and data available on SARS, and to provide access to computer tools for analyzing the SARS genome and proteins.*

*Two PENCE researchers, Chris Upton and Rachel Roper at the University of Victoria, quickly developed the SARS Bioinformatics Suite based on their work on the Poxvirus Bioinformatics Resource, which supports researchers working on vaccines and drugs against smallpox.*

*The SARS Bioinformatics Suite, available at [www.sarsresearch.ca](http://www.sarsresearch.ca), is primarily for research purposes but also contains links to information for the public, including the latest news on SARS. It provides scientists with a manually curated and annotated database of all available SARS genome sequences together with a variety of easy-to-use integrated tools for comparing and analyzing the genomes.*

*“The SARS Bioinformatics Suite provides ‘one-stop shopping’ for genomic information and analysis tools for the SARS virus. Its funding by PENCE enables us to support researchers worldwide and avoid wasteful duplication of resources,” says Dr. Upton.*

*Funding to continue to maintain and update the site has been awarded by PENCE in its latest competition for SARS research.*

PENCE held a second SARS funding competition in the spring of 2004. Through this competition a further \$444,500 was



committed to fund successful continuing projects, as well as two new projects.

Characterization of the virus and the problem of developing appropriate therapies is a continuing global effort. PENCE researchers and others around the world are developing strategies for targeting the virus at many different levels.

The main proteinase (an enzyme that cleaves other proteins) of the SARS virus (3CL<sup>pro</sup>) plays a crucial role in viral replication by mediating the cleavage of "polyproteins" into the functional units required for viral replication. Therefore, 3CL<sup>pro</sup> represents an excellent target for therapeutics to treat SARS, much as drugs targeting the HIV proteinase are used to treat AIDS.

One PENCE group (Eltis, Brown, Vederas, James, Wishart) contributed to the SARS initiative by employing two strategies to generate novel leads (potential drugs): high throughput screening (HTS) and rational design. HTS identified several small molecules that specifically block 3CL<sup>pro</sup>. The researchers have made the primary screening data set publicly available so that it can be used by others, such as those identifying structure-activity relationships in 3CL<sup>pro</sup> or other viral proteinases.

In the second strategy, the group used their knowledge of a related proteinase to design small molecule inhibitors of 3CL<sup>pro</sup>. Continuing studies of these leads and the crystal structures will investigate how they inhibit 3CL<sup>pro</sup> and their potential to provide a basis for innovative antiviral therapies.

"Our small molecule leads combined with emerging structural information puts us in a unique position to make an exciting contribution to the development of therapeutics for SARS," says Dr. Lindsay Eltis, a PENCE researcher at UBC.

Another PENCE group (Seidah and Chrétien) has been studying the role of proprotein convertases (PCs) in SARS infection. These host enzymes normally cleave specific cell surface proteins and enable the virus to fuse with the host membrane. The researchers have recently demonstrated that the SARS-CoV S protein is processed by PC-like proteases for the virus to be infectious and that inhibition of the PCs may represent an alternative strategy beneficial to patients infected with SARS-CoV. A PC inhibitor could possibly be used along with vaccination or in conjunction with Interferon treatment.

In view of the widespread implications of the PCs in the processing of various surface glycoproteins of infectious viruses, development of a small molecule inhibitor of the convertases is needed, as its usefulness will likely extend to other emerging infectious agents.

In other work by the Seidah lab, it was shown that chloroquine, a treatment for malaria, has strong antiviral effects on the SARS-CoV in specially manufactured cells that are infectable by the SARS-CoV. To date, no effective therapy has been reported, so these results are very encouraging. The effects were observed when the cells were either pretreated with the drug or treated after exposure to the virus, suggesting both a protective and therapeutic advantage. The antiviral effect observed may be due to a combination of factors including the increased pH in the cells and interference with various required processing of both the viral protein and its receptor.

In these, as well as in the other eight PENCE-funded projects, exciting and innovative research into SARS continues.

[www.pence.ca](http://www.pence.ca)



STEM CELL NETWORK (SCN)

*Discovery*

**Closing in on a cure for juvenile diabetes**

*The discovery of insulin-creating multipotent cells in the pancreas brings stem cell science another step closer to defeating Type 1 diabetes.*

A team of Canadian scientists has taken a big step forward in the journey to find a cell-based therapy to defeat diabetes.

Work at the University of Toronto, by Drs. Raewyn Seaberg, Simon Smukler, and Derek van der Kooy and team members across the country, has identified what has eluded scientists until now: a single cell in the pancreas capable of creating insulin-producing beta cells.

The findings, to be published in the September 2004 edition of *Nature Biotechnology*, represent a fresh new hope for diabetics in Canada and across the world who must undergo regular injections of insulin to compensate for defective pancreatic islet cells that regulate the body's blood sugar levels.

"This represents a potential cure for a deadly disease," says Dr. van der Kooy. "It wouldn't have happened – at least it wouldn't have happened in Canada – without the Stem Cell Network. This is an example of bringing together people with different expertise. And it worked out wonderfully."

In fact, the discovery could be a case study in cross-Canada collaboration. Dr. van der Kooy used "essentially the same assay" for identifying neural stem cells developed by Samuel Weiss at the University of Calgary. Because Dr. van der Kooy was unfamiliar with pancreatic cells (his expertise is retinal and neural stem cells), Timothy Kieffer,

now at the University of British Columbia in Vancouver, and Gregory Korbitt, a University of Alberta professor who worked on the Edmonton Protocol for islet transplants, provided the needed help.

"Their work was spectacular," said Dr. van der Kooy. "We had the techniques available, but we simply didn't have any background in studying pancreases. They provided the tissue that allowed us to proceed."

The discovery offers considerable new hope, as it contradicts a recently published paper that suggested no such cell exists in the pancreas.

"It's very exciting," says Joel F. Habener, Professor of Medicine at Harvard Medical School and Associate Physician at Massachusetts General Hospital. "An earlier paper in *Nature* said, essentially, there are no stem cells in the pancreas. So this is a highly important paper in the field. This paper shows there is a rare cell that has the property to be a precursor, be multipotent, and create insulin cells."

Many researchers have claimed there are adult stem cells in the pancreas, says Dr. van der Kooy. "They saw some new pancreatic cells being generated, but they didn't know which cells were doing it. We've shown that a single cell cultured from a pancreas can produce all the cells in the pancreas, including insulin-producing ones."

Dr. van der Kooy is careful to call the cell "a multipotent precursor cell" and not a stem cell. "If a stem cell is defined by its ability to proliferate and produce all the cells, then we've done that. But to truly show it's a stem cell, we have to show it can renew itself. We haven't shown that yet. We're working on it."

*"This represents a potential cure for a deadly disease. It wouldn't have happened – at least it wouldn't have happened in Canada – without the Stem Cell Network. This is an example of bringing together people with different expertise. And it worked out wonderfully."*

**Dr. Derek van der Kooy**  
Department of Medical Biophysics, University of Toronto





The discovery builds on a proud history of diabetes research in Canada, from the 1920s discovery of insulin by Frederick Banting and Charles Best, to the development of the Edmonton Protocol for islet transplantation in 2000 by University of Alberta researchers, which has freed some diabetics from insulin injections. Given that donor organs used in the protocol are in such short supply, this discovery could be a key to the future treatment of diabetes.

"If this process can be replicated in human tissue, and scaled up, it could provide a means of making the islet transplant protocol that was developed in Edmonton more widely available as a therapy for Type 1 (juvenile) diabetes," says Dr. Kieffer.

The next step, says Dr. van der Kooy, will be testing the cells in mice to see if they can rescue diabetes, a step that would bring them ever closer to a cure.

Robert R. Hindle, Chairman of the Board of the Juvenile Diabetes Research Foundation of Canada, calls the discovery "a tremendously encouraging step forward for everyone affected by juvenile diabetes. This is a very tangible demonstration of how the SCN has rapidly moved forward stem cell and stem cell-related research, which offers a wide array of therapeutic potential. At the same time, this discovery shows how rapidly specially focused research can zone in on the target. The SCN has created a unique forum to permit widespread multidisciplinary research across the world. It is worth noting that, once again, a major step forward in diabetes research has occurred in Canada."

[www.stemcellnetwork.ca](http://www.stemcellnetwork.ca)





SUSTAINABLE FOREST MANAGEMENT NETWORK (SFMN)

*North American sales top 1,400*

**Network’s encyclopedic reference book on sustainable forest management “not just for academics”**

*Compiling seven years’ work completed by the Sustainable Forest Management Network (SFMN) into a comprehensive summary may have seemed like a fairly straightforward task when first proposed in 2001, but no one anticipated that the project would grow to become a 1,000-page book that required four editors and 75 researchers to construct.*

The project, originally proposed by Dr. Christian Messier to provide a single source of information on boreal forest management, culminated with the Network’s launch of *Towards Sustainable Management of the Boreal Forest*, at the World Forestry Conference in Quebec City in 2003.

“The publication,” recalls former SFMN director Dr. Wiktor Adamowicz, was to cover four areas: “What we know at this point; the management practices or policies that we should think about changing or implementing now; some areas where we still need research before recommending change; and some longer-term research questions.”

The target audience included forest managers; professionals concerned with forest policy issues; resource managers; private sector companies working in the forest sector; and Aboriginal communities – in essence, all of the Network’s partners.

“So the target audience,” explains Dr. Adamowicz, “naturally led to a certain group of authors who were comfortable in writing for that target.” Some of the chapters, he points out, were jointly authored by SFMN researchers and members of the Network’s partner community.

Dr. Philip J. Burton, at the time a consultant who owned Symbios Research & Restoration, was contracted to coordinate

***Almost everything from A to Z – The state of the art in sustainable management of the boreal forest***

*Among themselves, SFMN researchers sometimes joke that their network runs from A to Z – anthropology to zoology, that is. Their 1,000-page “summary” of the state of the art in sustainable forest management meets that description too.*

*Organized in five parts and 23 chapters, the book offers more than a summary of SFMN’s work to date: it also reviews the state of the art around the world.*

***Part 1 outlines the Goals of Sustainable Forest Management***, starting with a brief history of its evolution, followed by an exploration of sustainability within the boreal forest environment.

***Part II examines the Social and Economic Dimensions of Sustainable Forest Management*** as the “ultimate drivers” for forestry-related developments in research, management, and engineering.

***Part III, Forest Ecology and Management***, explores the processes and effects of natural disturbances such as wildfires and insect outbreaks, comparing their effects on aquatic and terrestrial ecosystems with the effects of timber harvesting on the same systems.

***Part IV, Minimizing Impacts of Forest Use and Fibre Processing***, focuses on technical solutions to pollutants generated by the pulp and paper industries.

the book project and heads its list of editors (Doctors Messier, Daniel W. Smith and Dr. Adamowicz are the others.)

Dr. Burton, who has since become a manager with Natural Resources Canada’s Canadian Forest Service, points out that the SFMN





had several longer-term goals in mind for the book. One was to establish benchmarks that could be used to evaluate further advances in forest management practices. Another was for the book to become a catalyst for accelerating change in the forest management policies and practices of not only Canada but also other countries with boreal forests, such as Finland and Sweden. The book attracted great interest in Russia, for example, when Dr. Burton reviewed its key messages in his keynote address at a conference on Boreal Disturbance Dynamics.

While Dr. Burton emphasizes that it's too early to determine whether the book is meeting these goals, he says the indicators are promising. "Sales in North America topped 1,400 in the first year, and in many jurisdictions – such as the United States and Scandinavia –we're seeing general recognition of the benefits of solutions that promote environmental conservation simultaneously with promoting economic efficiencies."

Furthermore, Dr. Burton feels that the book's specifically Canadian focus contributes to its potential for making a difference in future management of Canada's boreal forests.

"There are other compendiums," he explains, "but they are usually published as the proceedings of conferences or workshops related to specific topics, such as conservation of old-growth forest or ecosystem management for Pacific Northwest forests. None have an exclusive Canadian or boreal focus."

In addition, forest managers and other potential users need no longer search Web sites and publication listings to access SFMN's seven years of research results specific to Canada's boreal forests: highlights of the approximately 300 technical publications produced by the Network to date are all in the book.

Finally, the book can serve as a textbook for educators in the field. "While we didn't deliberately plan it to become a textbook, we did have the university audience in mind. I don't know if it is being used in universities yet, but it is already a required text for a forestry continuing education program in Alberta," says Dr. Burton. He hopes it will be used to support a senior or "capstone" course in many of the country's forestry schools.

As Dr. Adamowicz commented during the publication's September 25, 2003, launch at the 12th World Forestry Congress in Quebec City, "This book illustrates in a profound way what the SFM Network is really all about. The book sheds light on many ecological, social, and economic issues that we investigated and researched from 1995 to 2002."

[www.ualberta.ca/sfm](http://www.ualberta.ca/sfm)