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A Leopard tank bakes in a simulation of the midday Afghan sun.

Troops beat the heat in Kandahar

"We created high noon in Kandahar."

Don LeBlanc, National Research Council Canada

No matter what their views on the war in Afghanistan, Canadians agree that protecting the health and wellness of troops overseas is a top priority. The crews of Canada's Leopard tanks in Kandahar got some relief from the searing desert heat this summer thanks to cooling vests that were tested in a giant oven at NRC.

Last February, NRC engineers recreated the Afghan summer in an environmental chamber that produces temperatures ranging from -51°C to +55°C. They subjected a Leopard tank to desert-like temperatures of 44°C while armed forces volunteers performed drills that simulated their duties

in the field, such as loading and unloading the tank's 105-mm gun.

The heavily armed Leopards were sent to Afghanistan last year because they offer the best protection against roadside bombs and mines. But the military was concerned that the internal temperature of the tanks would rise above 50°C in the summer heat.

"Those kinds of temperatures would cause heat strain in the crew, which could impair their mental and physical performance, putting them at risk in tactical situations," says Dr. Ira Jacobs of Defence Research and Development Canada (DRDC) in Toronto.

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Skin health check goes high tech

Medical imaging technology developed at NRC can help doctors immediately assess the health of injured or transplanted tissue – by providing a rapid snapshot of its blood and oxygen levels. Calgary-based Kent Imaging, which has licensed the technology, is developing a handheld version, opening the door for widespread clinical use.

"Our technology is geared for areas of medicine where doctors do visual assessments – such as treatment of wounds, burns, skin lesions or skin transplants," says Dr. Michael Sowa, spectroscopy group leader at the NRC Institute for Biomedicine in Winnipeg. "The technology's premise is that for tissue to survive, it needs blood and oxygen. If those ingredients are missing, the tissue will not survive a transplant or trauma."

Normally, it takes doctors up to three days to determine whether tissue is dying, but the NRC technology can help them make that call instantly to re-supply the tissue with blood and oxygen as quickly as possible. "The NRC technology is very easy to use," says Dr. Karen Cross, a plastic surgery resident at the Ross Tilley Burn Centre of Sunnybrook Hospital in Toronto. "It takes one minute to collect information directly from a patient's wound."

So far, the NRC technology has been tested by Sunnybrook Hospital for five years. There, Dr. Cross and other clinical researchers have

shown that a prototype imaging device can accurately and rapidly distinguish between first- and third-degree burns, and is also "patient-and hospital-friendly."

Normally, it takes doctors up to three days to determine whether tissue is dying, but the NRC technology can help them make that call instantly.

The NRC team is now starting a clinical study at the Health Sciences Centre in Winnipeg to look at the technology's effectiveness in helping surgeons assess the health of reconstructed breast tissue after a mastectomy. In this procedure, surgeons transplant a tissue flap from the patient's abdominal area. "The idea is to use an imaging device right in the operation room to ensure the flap tissue will survive after the surgeons suture it in place," says Dr. Sowa.

Meanwhile, Kent Imaging is developing a smaller, faster, more ergonomic and affordable version of the NRC imaging technology for use in operating rooms, recovery wards and other clinical settings. "We believe we can do this within a handheld camera system that's slightly smaller than an 8.5 x 11 inch page," says Donald Chapman, the firm's chief



Medical imaging technology developed at NRC (shown above) can help doctors immediately assess the tissue health of their patients.

executive officer. "It would include an LCD panel on the back to give physicians a large-scale picture of what they're looking at."

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President's outlook

Dr. Pierre Coulombe
National Research
Council Canada



New approaches, new partnerships for health

The federal S&T strategy, *Mobilizing Science and Technology to Canada's Advantage*, points to the need to create a Canadian "knowledge advantage" in areas of national interest. Health and wellness are a clear national priority – and health-related sciences and technologies are fields in which NRC excels.

NRC stands among several high-calibre research organiza-

tions and networks working to reduce the incidence and impact of diseases that are taking their toll on Canadians.

In collaboration with partner organizations, our scientists and engineers conduct innovative research and develop impressive technologies to quickly and accurately diagnose disease. Their work also benefits Canadians by

minimizing the effects of other health risks and medical conditions, including age-related and infectious diseases; neurological, immunity and obesity-related disorders; indoor environment hazards; and chronic diseases such as cancers.

NRC researchers are developing technologies to detect viruses, bacteria and toxins; immunotherapies and vaccine technologies; and certified measurement standards for supplements or health products.

Through our technology cluster initiatives, NRC and community partners in Charlottetown, Fredericton, Halifax, Ottawa, Winnipeg and Saskatoon are teaming up to achieve health advantages through nutrisciences, information technology, life sciences, photonics, biomedical technologies and plant biotechnology. Together they are making great strides. For example, they are identifying land- and marine-based bioactive compounds to treat a variety of neurodegenerative diseases such as Alzheimer's, and making groundbreaking agricultural biotechnol-

ogy products. They are also developing medical devices to better diagnose cardiovascular disease, and applying bioinformatics to detect prostate cancer.

Within these technology clusters, NRC researchers collaborate with industry, universities, hospitals, other R&D organizations, various levels of government, and granting councils. But our researchers also work alongside their private and public sector colleagues to contribute to other established networks like Montréal's biopharmaceutical cluster. There, NRC performs leading-edge research serving the pharmaceutical and environmental industries, focusing on new strategies for treating diseases, and on preventing and cleaning up pollution.

Going beyond traditional collaborative approaches, this summer NRC struck an alliance with the research institute of the McGill University Health Centre (MUHC). MUHC laboratories have been moved into the NRC Biotechnology Research Institute in Montréal where researchers from both

organizations will collaborate on joint health projects.

MUHC researchers will benefit from NRC's ultramodern facilities and expertise in health biotechnologies, technology transfer and intellectual property management, as well as greater interaction with pharmaceutical and biopharmaceutical companies.

In turn, our researchers will be able to work closely with researchers from one of Canada's largest university hospital centres, benefiting from new synergies with MUHC's experts in clinical research, health care and biomedical research. This McGill relationship signals a new partnership approach as a university-based research institute moves into a federal facility to work more closely with NRC.

By combining the strengths of NRC and MUHC, we are making the most of the resources and expertise available in both organizations. For Canadians, it will mean new medical technologies and new solutions that will benefit patients directly. ■

Proteins as drugs: biotherapeutic discoveries unveiled

Thanks to remarkable advances in the field of protein therapeutics, people with serious illnesses will soon have access to safer, more effective medications. And the discoveries presented at the 2007 Crossroad of Biotechnology symposium in June this year may well contribute to their development.

Protein-engineered drugs are big business. According to a February 2007 *Business Insights* report, the world market in 2006 was almost \$67 billion and is projected to rise to \$118 billion in 2011. Sales in the insulin, erythropoietin and interferon segments of the market have been strong while innovative protein-based cytostatic, immunosuppressive and anti-inflammatory agents are also quickly gaining prominence.

On June 13 and 14, leaders from the pharmaceutical and biopharmaceutical industries attended the 2007 Crossroad of Biotechnology symposium hosted by NRC in Montréal to hear about the latest discoveries, trends and commercial applications of protein therapeutics. Bringing potential industry partners together with prominent researchers is an important first step toward bringing innovations on stream for further development.

Dr. Michel Desrochers, Director General of the NRC Biotechnology Research Institute in Montréal, sees the biomedical research sector as extremely important to

Canadian industry. "Of the 400 biotech companies in Canada, at least 150 are working on protein therapeutics," he noted. "More than half of the new drug applications filed worldwide concern protein therapeutics for cancer and infectious diseases and cover fields ranging from the central nervous system to cardiovascular, respiratory, pain, hormonal, metabolic and gastrointestinal applications."

The field of protein-based therapeutics has now reached a level of maturity which will allow for the next wave of breakthroughs, noted Bernard Prigent of Pfizer Inc. "Still, further efforts are required to develop partnerships linking researchers, industry, governments, policy makers and health systems managers so that the fruits of innovation are quickly taken into health systems where they will reach those who need them."

The Crossroad symposium highlighted some exceptional recent developments in biotherapeutic research. Speakers from Canada, the United States, the United Kingdom, Germany and Switzerland described their discoveries and how they might lead to applications in medicine. Since it began in 1995, the annual Crossroad of Biotechnology has become a key meeting for biotech R&D managers as well as executives from financial institutions and venture capital firms. This unique NRC-

hosted event bridges the biotechnology and pharmaceutical industries at the crossroad of the European and North American markets.

BioTransfer – bringing discoveries to industry

For the first time at the annual Crossroad symposium, McGill University and NRC leveraged their collective strengths by showcasing promising new technologies at a special event for potential private-sector partners.

During the BioTransfer session, industry stakeholders learned about 24 revolutionary, ready-for-licensing technologies specially selected by NRC and the McGill Office of Technology Transfer. Among them were discoveries of biologicals that can help heal chronic wounds, and potent anticoagulants to prevent pathogenic blood coagulation – a major cause of death in western societies.

As highlighted by NRC's Dr. Desrochers, "NRC and McGill University both generate considerable intellectual property in biotechnology and both institutions were very pleased by the interest private companies took in acquiring new technologies." In May 2007, the McGill University Health Centre and NRC announced an agreement to jointly promote research and the marketing of new therapeutics and diagnostic kits to help patients benefit from the latest biotech innovations. ■

Troops beat the heat in Kandahar

Continued from page 1

The armed forces had a possible solution – cooling vests – but the vests had yet to be proven in the harsh conditions of Afghanistan.

In late 2006, National Defence approached NRC to create a realistic testing ground for the vests. It wasn't the first time that NRC's expertise in simulating extreme climates had helped the armed forces to prepare for difficult situations. Past trials have included ice and snow simulations for the Leopard tanks, which troops have used to patrol some of Canada's coldest regions.

Before the test, NRC engineers outfitted the Leopard tank with

additional armour that was being used to reinforce tanks in Afghanistan. Design, welding and integration expertise went into the upgrade. To simulate the Afghan sun, NRC's engineers and technicians installed 300 halogen bulbs – at 500 watts each – in the environmental chamber. They stripped the bulbs of their protective glass to increase the UV radiation. "We created high noon in Kandahar," says Don LeBlanc, manager of the climatic engineering chamber at NRC in Ottawa.

NRC staff slathered on SPF 60 sunscreen during preparations for the test, which also included

installing a solar shield – a large sheet of insulating material developed at DRDC Valcartier – that covers the tank and could help to reduce its skin temperature. The tank's exterior can reach a blistering 80°C in the sun.

Three volunteers, all trained Leopard tank crew, performed simulated manoeuvres inside the tank wearing first their usual gear, then their gear with the addition of the cooling vests. The vests circulate chilled fluid to keep the body's core temperature down.

"We found that with the cooling vests, the crews could operate the tanks for a much longer period of time," says LeBlanc. He added that the vests may even provide a tactical advantage over an adversary that typically chooses not to fight

during the worst heat of the day.

With the tests complete, the vests were delivered to Afghanistan in time for summer, and received excellent reviews from the troops. "The cooling vests are absolute life savers," says Major A.K. Welsh, National Defence project manager for the NRC test. "They have made the difference between our crews

becoming heat casualties to being able to work comfortably through all hours of the day. We are extremely grateful for the support we received from NRC to implement this solution."

NRC's special climatic engineering facility is available for testing how various vehicles, their equipment, cargo and crew, stand up to extreme heat and cold. ■

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NRC-CNRC
Industrial Research
Assistance Program

NRC-IRAP

Helping Canadian Businesses

The NRC Industrial Research Assistance Program (NRC-IRAP) provides a range of both technical and business oriented advisory services along with potential financial support to innovative Canadian small- and medium-sized enterprises.

The program is delivered by an extensive integrated network of 260 professionals in more than 100 communities across the country. Working directly with these clients at the company's facility, NRC-IRAP supports innovative research and development and commercialization of new products and services.

To reach an advisor in your community, please contact us at:

1-877-994-4727

or visit our website at:

irap-pari.nrc-cnrc.gc.ca

National Research Council Canada
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Canada



SUPPORTING INNOVATIVE COMPANIES



From left to right: The Hon. Jim Prentice, Industry Minister; Dave Batters, Member of Parliament – Palliser, SK; Pierre Coulombe, NRC President; and Sean Frisky, CEO, Ground Effects Environmental Services (GEES); participate in a GEES facility tour in Regina.

On September 13, Canada's Minister of Industry, the Honourable Jim Prentice, presented Ground Effects Environmental Services with a Canadian Innovation Leader certificate in Regina, Saskatchewan. The company is a leader in soil remediation and environmental clean-up technologies.

CEO Sean Frisky credits NRC for playing a role in the company's success. "The support we received

from NRC-IRAP helped Ground Effects to carry out the required research and development to bring EK3 [a new salt remediation process] to market, and without the advice we received from NRC-IRAP, this project would not yet be complete and out in the field, cleaning up our environment." ■

Taste omega-3 goodness, not the sea

Imagine drinking a glass of orange juice or letting chocolate melt in your mouth while getting the nutritional equivalent of eating fish. That's the idea behind "functional foods" – a rapidly growing industry trend a young Halifax company is riding on.

Today, only ten years after its inception, Ocean Nutrition Canada claims to be the world's leading provider of top-quality omega-3 fish oil as a nutritional supplement and functional food ingredient. NRC is proud to have helped this company build a solid foundation for success.

Omega-3 oils, clinically proven to improve heart health and mental functioning, are gaining attention as a promising treatment for arthritis, depression, macular degeneration and other chronic conditions. But eating fish isn't for everybody. Adding omega-3s to manufactured foods like bread is an inexpensive way to ensure people get the health benefits without having to buy expensive supplements.

"The challenge has been to provide omega-3 fish oil in a formulation that won't give foods an unpleasant taste or smell," says Ocean Nutrition Canada's President, Robert Orr. "That's where our company's patented micro-encapsulation technology has given us a distinct competitive advantage."

This unique technology stabilizes and transforms fish oil into a powder finer than flour. Ocean Nutrition Canada's MEG-3® powder can withstand baking and has no fishy taste or smell, making it easy to add to bread, milk, yogurt and other products.

Thanks to effective marketing, the company has seen steadily rising sales since patenting its encapsulation technology. This year alone, food manufacturers on several continents have struck agreements with Ocean Nutrition Canada to

incorporate MEG-3® fish powder into their products.

Danone and Tropicana, two major North American manufacturers, now display the MEG-3® logo on their yogurt and juice. A Canadian chocolate manufacturer has recently followed suit as have

companies producing baby food, nutritional bars, bread, pizza and other ready-made foods.

Even Dr. Andrew Weil, America's best-known health guru, recently began incorporating Ocean Nutrition's fish oil ingredient into his own dietary supplements. "We

decided to switch to the Meg-3 EPA/DHA fish oil because Ocean Nutrition offers high-quality, molecularly distilled fish oil that is stringently tested for heavy metals and other contaminants," Dr. Weil stated in a company news release.

Ocean Nutrition Canada is gearing up to capture a big share of the emerging functional foods market, estimated to be worth billions. "The omega-3 opportunity is huge right now," says Orr. "We're increasing our production capacity and enhancing our refining and encapsulation technologies so that our omega-3 products can be incorporated into a wider variety of foods." As Orr sees it, once the company has strong, steady revenues from the omega-3 market, it will resume the R&D it had begun on several other marine-based bioactive compounds.

Employment at Ocean Nutrition Canada jumped from 30 people in 1998 to 360 in 2006. The company's current annual revenues are running at \$100 million with clients in the US, Canada, China, Europe and Australia.

Over the last eight years, the NRC Industrial Research Assistance Program has been a guiding partner in the development of the company's R&D strategy and the commercialization of its new technologies. As a percentage of sales, Ocean Nutrition Canada invests more in R&D than any of its competitors and has more than 60 patented technologies, many now licensed to other firms.

Since only a tiny fraction of marine compounds have been identified and characterized, the ocean's the limit when it comes to this Canadian company's growth. ■



The NRC Industrial Research Assistance Program (NRC-IRAP) has supported Ocean Nutrition Canada since its inception, providing technical guidance, contact with top scientists, R&D project planning support and funding. NRC-IRAP also recently helped the company develop and commercialize an immune-boosting supplement.

"No other organization could have collaborated more effectively as we developed our products and processes," says President Robert Orr. "In our early days, NRC-IRAP connected us with experts such as Professor Bob Ackman – Canada's top authority on marine oils and omega-3 fatty acids. And that was just the beginning."

Ocean Nutrition Canada is currently working with NRC-IRAP on developing a blood-pressure lowering supplement, omega-3 oils from marine micro-algal sources, and an inexpensive Kosher MEG-3® powder.



Fertile ground for biotech firms

“NRC provides ... an understanding of the business opportunities Chemaphor is addressing.”

David Hankinson, Chemaphor



From left to right: Graham Burton, CEO, Chemaphor; Richard Brown, Minister of Development and Technology, Government of PEI; Janusz Daroszewski, Senior Research Officer, Chemaphor; Roman Szumski, VP Life Sciences, NRC; and Patrick Dorsey, VP PEI and Tourism, ACOA.

On July 9, 2007, Chemaphor Inc. officially opened its research quarters, the first of four biotech startups to reside in NRC's latest industry partnership facility (IPF). The new facility is located at the NRC Institute for Nutrisciences and Health in Charlottetown, Prince Edward Island.

When new firms rent space, they “incubate” in a full-service R&D laboratory

with access to NRC expertise, technical information, business planning services, and opportunities to benefit from research collaborations. The four current occupants of the Charlottetown facility are Chemaphor, Neurodyn, the Atlantic Centre for Bioproducts Valuation, and Nautilus Bioscience Canada. Each is focusing on a different but complementary

aspect of health-related research.

“By co-locating with us during their formative years, these firms benefit from the shared infrastructure and research programs resulting from NRC's partnership with the University of PEI and Agriculture and Agri-Food Canada,” comments Paul Neima, who manages the NRC partnership facility.

“Chemaphor management was delighted when the opportunity arose to become part of the industry partnership program, because NRC provides scientific strength and an understanding of the business opportunities Chemaphor is addressing,” says David Hankinson, Chairman of the Board and Director of Nutrisciences, Chemaphor. “NRC staff linked us with other agencies within the PEI Biosciences cluster and with the University of PEI. We have several collaborations underway that would not have materialized without help from NRC.”

Chemaphor, an NRC spin-off, develops premium products for the animal health, cosmetics, pharmaceutical and specialty chemical markets. It recently won funding from the Atlantic Canada Opportunities Agency (ACOA) to research the potential human and animal health benefits of carotenoid compounds. Such compounds could be used in pet products, growth-promoting livestock feed, and even anti-ageing skin creams.

“Young companies simply don't have the resources and connections to begin a demanding R&D program on their own,” says Mr. Neima. “We provide access to the sophisticated tools, equipment and scientific support they need, while opening doors to funding and assistance from other sources. For example, we connect them with the NRC Industrial Research Assistance Program and help them develop a research plan for submission to programs such as the Atlantic Innovation Fund run by ACOA.”

Another tenant, Neurodyn Inc., is developing products to detect and treat neuro-

degeneration resulting from ALS (amyotrophic lateral sclerosis), Parkinson's and Alzheimer's diseases. The company has developed an animal model capable of replicating neurodegeneration from its earliest stages, making it an excellent tool for testing potential new diagnostics and therapeutics. Neurodyn intends to operate as a clinical research organization at the service of pharmaceutical firms.

Incorporated in July 2007, Nautilus Bioscience Canada moved into the NRC partnership facility the same month. Working hand-in-hand with the University of PEI (UPEI), this firm explores natural products found in the ocean, focusing on biocompounds that could lead to new medications. One of its main areas of focus is terpenes, a class of compounds highly valued for their anti-inflammatory and cancer-fighting properties.

The Atlantic Centre for Bioproducts Valuation – a collaboration between NRC's nutrisciences institute and UPEI's Atlantic Veterinary College – has also set up quarters in the facility. By conducting preclinical studies and providing tools to screen compounds, the Centre will contribute to new treatments for strokes, neuroinflammation and metabolic disorders. It may also offer its services to the other three firms, helping their research along.

By the end of their three-year tenancy, Mr. Neima expects these firms will have validated their technologies, obtained intellectual property protection, and attracted venture capital to take their business to the next stage. In the meantime, these companies are benefiting from a thriving research community that has a vested interest in their success. ■

Have a young tech company that needs a good starter home?

For IPF locations and details, visit: www.nrc-cnrc.gc.ca/doingbusiness/colocating_e.html



UPCOMING EVENTS

Emerging Photonic Applications in Medicine, November 13–14, 2007 in Taipei, Taiwan

This workshop focuses on emerging optical technologies to improve medical diagnostics, including non-linear optics, optical coherence tomography, terahertz technology and surface-enhanced optical technologies. This Canada-Taiwan Bilateral Workshop marks the 10th anniversary of collaborations between Canada's NRC and Taiwan's National Science Council. For details: contact Alex Ko by email alex.ko@nrc-cnrc.gc.ca

Fire Safety Research for Better Building Design, multiple 2007–2008 dates at locations across Canada

This seminar provides practical fire safety information for construction professionals engaged in the design and construction of new and existing buildings, the management and operation of facilities, and the application of building and fire codes. Code compliance issues will not be addressed. In the past decade, significant advances in fire engineering and the understanding of human behaviour have and continue to contribute to better and safer buildings. For details and dates for each city: consult irc.nrc-cnrc.gc.ca/pubs/bsi/2007/reg_e.html

Decoding canola's DNA

Canadians have provided GenBank, the global DNA bank, with a major injection of DNA sequences for “Canada's plant.” Building on a long-standing partnership, teams of federal researchers from NRC and Agriculture and Agri-Food Canada (AAFC) made the single largest deposit ever of DNA sequences for *Brassica napus* (canola) and related species.

This major submission marks nearly 90 percent of all submitted Brassica expressed sequence tags. These new additions – 437,000 tags from NRC and 160,000 from AAFC – are especially timely, because they will be valuable for helping annotate the *Brassica rapa* genome, which is being sequenced as part of an international research community effort.

“Genome Canada is enthusiastic about the results of this genomics research, which will bring improvements not only to Canada's food and agriculture industry but to every citizen through health and economic advancements,” said Dr. Martin Godbout, President and CEO of Genome Canada. Canola accounts for an annual economic value of approximately \$11 billion for Canada's agri-food industry.

Most Canadians recognize the benefits of canola as a high quality and healthy vegetable oil used for cooking, salad dressing and margarine. But this versatile oil is now gaining prominence as a potential ingredient for manufacturing environmentally friendly products such as bioplastics and biodiesel.

In a world concerned with renewable fuels, canola and its derivatives present a valuable opportunity to address issues of climate change. This vital crop is particularly well positioned to serve as a feedstock to fulfill the targets of Canada's pending *Clean Air Act* that will require two percent biodiesel blends in diesel and heating oil by 2012. ■



Landmark work “lights the way”



PLM lights the way in this high-rise stairwell.

An NRC researcher has been officially recognized for helping to improve safety in buildings across Canada and around the world. In June 2007, Dr. Guylène Proulx received a Public Service Award of Excellence for her landmark studies on smoke alarms, photoluminescent material (PLM), and human behaviour during emergencies.

Dr. Proulx's research has raised awareness of the benefits of PLM emergency way-guidance systems. PLM can store energy from natural and artificial light, and becomes highly visible in darkness so people can safely evacuate a building that lacks power or is filled with dense smoke.

In Europe, PLM has been used for decades in industrial settings, such as on North Sea oil platforms, but not in commercial high-rises. While PLM was virtually unknown in North America in the early 1990s, Dr. Proulx knew about the product, having completed part of her PhD in architectural planning in England.

Early in her career, she was invited to participate in the investigation of the 1993 World Trade Center (WTC) bombing, where several thousand office workers were forced to evacuate in total darkness. Following the investigation team's recommendations, a PLM emergency way-guidance system was installed in all WTC stairwells. This installation proved invaluable during the 2001 terrorist attacks, when virtually everyone who could escape the twin towers did.

In the aftermath of September 11th, Dr. Proulx was invited to study the evacuation process. “We asked survivors if the PLM had been useful,” she says. “At least one-third of people said they had noticed the PLM in the stairwells and that it was reassuring to know they were going the right way.” Today, PLM systems are required in all high-rise office buildings in New York City.

A few years earlier, Dr. Proulx and colleagues at the NRC Institute for Research in Construction (NRC-IRC) had conducted the first controlled study of PLM way-guidance systems during an evacuation – in partnership with Public Works and Government Services Canada and JALITE PLC, a British firm. Their results showed

that building occupants can evacuate as efficiently in a stairwell marked with PLM as in a stairwell equipped with traditional emergency lighting.

Last fall, Dr. Proulx and her colleagues conducted a second study on PLM markings to evaluate the performance of different installations. During a surprise fire drill in an Ottawa office tower, employees were videotaped going down stairwells to help NRC researchers measure their movement time and ability to find destinations. “We found that people could exit very easily and comfortably with the photoluminescent material, and we identified the best way to mark a stairwell using PLM,” says Dr. Proulx.



Guylène Proulx receives a Public Service Award of Excellence from (left) Clerk of the Privy Council and Secretary to the Cabinet Kevin Lynch and NRC President Pierre Coulombe.

Mobile magnet pulls award-winning team to spotlight

The 2007 Federal Partners in Technology Transfer (FPTT) national meeting and awards event in Halifax, Nova Scotia, honoured NRC, an NRC spin-off, and a physician-collaborator with an FPTT Excellence in Technology Transfer Award. They received the award for “the successful development, transfer and commercialization of a mobile MRI system for neurosurgical operations.” The mobile system, a world first, is “saving lives while reducing post-surgical complications, patient wait times and overall health costs.”

FPTT named the NRC Institute for Biodiagnostics (NRC-IBD), IMRIS Inc. and the Seaman Family MR Research Centre / the University of Calgary as the recipients of the FPTT Excellence in Technology Transfer Award.

Developed by NRC-IBD in Winnipeg, the intraoperative system is designed so that the retractable magnet can be moved over a patient at any time before, during or immediately after surgery. IMRIS Inc., a Winnipeg-based start-up created in 1998 to commercialize the system, now



Mobile MRI intraoperative system, image courtesy of IMRIS Inc.

employs 84 highly skilled people, and expects to add more than 40 jobs by 2008.

At the early developmental stage, NRC provided space for the company in its Winnipeg incubation facility, as well as scientific and technical expertise needed to develop, install and operate the first system installation at Foothills Hospital,

Calgary. Since then, more than 800 neurosurgical procedures have been performed at a number of installations, including hospitals in Calgary, Boston, Wilkes-Barre, Pennsylvania and Fort Worth, Texas. ■

Skin health check goes high tech

Continued from page 1

In addition to burn and transplant assessments, the technology has other potential roles such as assessing vascular diseases, ophthalmologic and other conditions, says Chapman. “For example, one problem faced by people in the late stages of diabetes is getting adequate circulation in their lower extremities. This technology has the potential to actually monitor the effects of drugs on circulation.”

“It could also be used for any kind of plastic surgery and for monitoring wounds,” he adds. “Or, you could check patients for circulation problems that could ulcerate and become bed sores.”

“The best part is, the technology is completely non-invasive,” Chapman stresses. “It takes a picture. There's no need for fluid injections, dyes, fluorescence or anything else.”

The NRC technology consists of an infrared light source and a highly sensitive camera that records reflected light. It measures specific wavelengths – most of them invisible with the naked eye – and through a series of complex mathematical calculations, determines whether injured or transplanted tissue has an adequate blood supply and if the blood is carrying enough oxygen.

Kent Imaging hopes to start commercializing this technology in 2008. ■



Surgical robot revolutionizes brain surgery

Thanks to a combination of remarkable technologies, "NeuroArm" promises to dramatically increase surgical accuracy and safety.

Brain surgery has stepped into a bright new era where high-precision robots will do the job, guided by sophisticated imaging systems and a surgeon's skill at a computer. "NeuroArm" – the world's first MRI-compatible, image-guided surgical robot – promises to dramatically increase surgical accuracy and safety by liberating it from the constraints of the human hand. Patients should see better surgical outcomes and fewer repeat surgeries for tumours that can grow back if not completely removed.

Unveiled in Calgary in April 2007, NeuroArm is the brainchild of Dr. Garnette Sutherland, professor at the University of Calgary's Faculty of Medicine and neurosurgeon for the Calgary Health Region. In a six-year project that turned concept into reality, Dr. Sutherland guided a multidisciplinary team of Canadian university and industry-based scientists, including NRC biodiagnosics and materials researchers. NeuroArm was built in collaboration with MacDonald, Dettwiler and Associates Ltd., the Ontario-based robotics company that built the two Canadarms used on NASA space shuttles.

"NeuroArm offers enhanced dexterity and accuracy, even at microscopic levels," Dr. Sutherland explains. "Surgeons will no longer have to stand over a patient's head for hours, fighting off tremor or fatigue while executing high-precision work. This new technology allows surgeons to manipulate tools from a computer workstation, leaving the actual surgery to the robotic arm," he says.

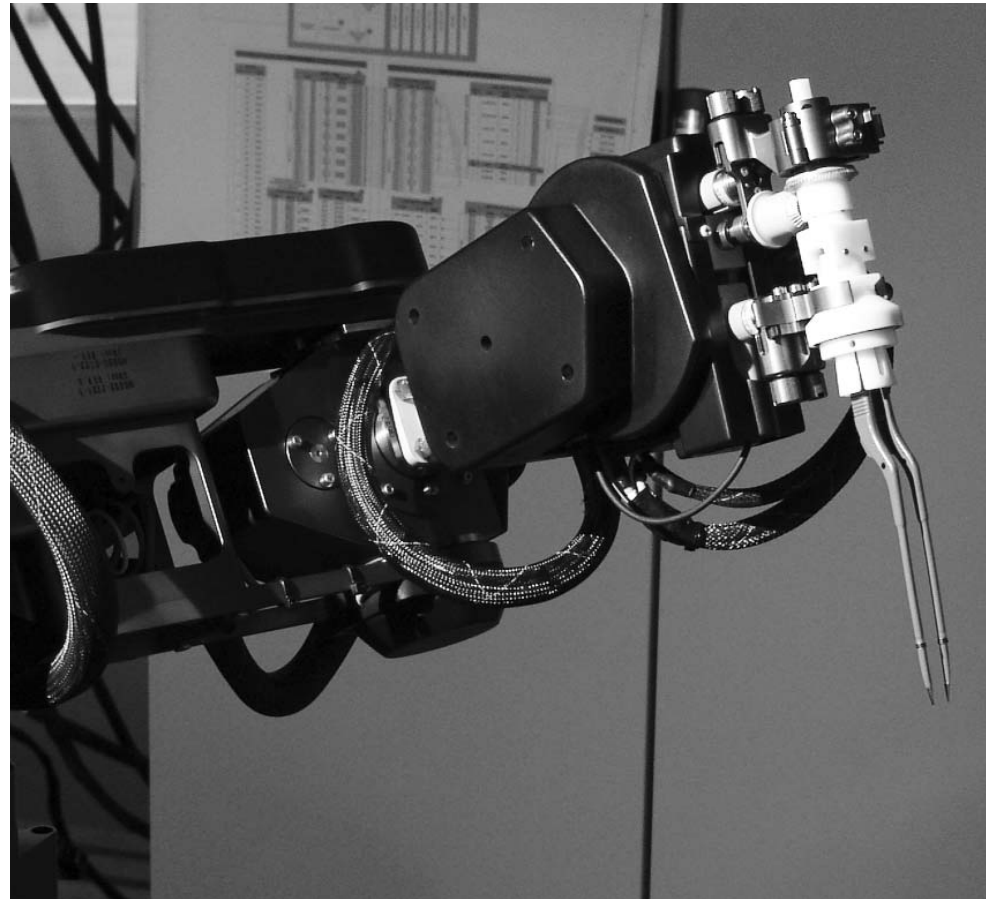
NeuroArm came to life through a unique partnership among medical, engineering and physics researchers as well as philanthropists, government organizations and the high-tech sector. Dr. Sutherland credits

NRC and its spin-off company, IMRIS, for one of the major attributes of NeuroArm: its capacity to integrate high-resolution real-time imaging of the brain during an operation.

Dr. Boguslaw Tomanek leads NRC's magnetic resonance (MR) team in Calgary. Several years ago, he and Dr. Scott King, who manages NRC's magnetic resonance prototyping facility in Winnipeg, began working with Dr. Sutherland on ways to combine MR imaging with robotics. He remembers early conversations with the visionary Dr. Sutherland who wondered whether surgeons – connected to a space mission by computer – could one day guide a surgical robot to operate on a sick astronaut orbiting in space. "Dr. Sutherland was extremely curious about technology, and was very open to new ideas," recalls Dr. Tomanek.

NRC's expertise in magnetic resonance imaging played a significant role in developing NeuroArm. "Several years ago, we designed and made the prototype of the intra-operative MRI system now installed at Calgary's Foothills Hospital," says Dr. Tomanek. "That basic technology was commercialized by IMRIS, and many surgeons were trained to use it. The work to create the MRI-compatible robotic arm came out of this earlier work on imaging systems."

In the field of magnetic resonance imaging, NRC is known for its expertise in radio-frequency (RF) coils. "The coil creates the radio frequency field needed to image internal organs. Correct positioning, high image quality and orientation of the coil are critical as the magnet moves over the patient's brain, yet the coil cannot get in the way of the robotic arm," says Dr. Tomanek. "We had to design a dedicated RF coil



NeuroArm can manipulate tools with a level of dexterity far exceeding that of a human. Photo credit: Jason Stang, University of Calgary

to accommodate the robot's access to the brain."

In addition to designing a unique RF coil with access portals, NRC also guided research on the innovative materials required to make the robotic arm compatible with MRI scanning during surgery. "We performed a great deal of computational work to come up with an RF coil design and materials that would work properly together," says Dr. Tomanek. "And, given the requirements of the operating theatre, the coil had to be made of materials that could be regularly cleaned and sterilized."

At the unveiling event in April,

Dr. Sutherland expressed his gratitude to the many top-notch researchers and other partners who helped make this remarkable tool a reality. And, showing his visionary spirit, he alluded to the potential to take it to the next level. "By incorporating advances in nanotechnology, molecular engineering and neuromodulation into the next generation of NeuroArm, we will be able to enhance treatment outcomes even more."

NRC's contributions to the NeuroArm aren't over yet – researchers in Boucherville are developing software for training on how to surgically manipulate biological tissues. ■

A quarter billion dollar payback for taxpayers

Research by a single NRC institute has helped Canadian high-tech firms earn almost a quarter of a billion dollars in estimated sales since 1990, a clear demonstration of the value for Canada from the transfer of technology out of federal laboratories.

A recent study by Ottawa-based Doyletech Corporation, commissioned by the NRC Institute for Information Technology (NRC-IIT), found that economic payback from NRC-IIT falls into two broad categories: sales and employment of firms that have licenses or have purchased technology from NRC-IIT; and sales and employment of firms whose origins can be clearly traced to the transfer of people and/or technology from NRC-IIT.

The Doyletech analysis shows that in the 16 years from 1990-1991 to 2006-2007, NRC-IIT received nearly \$8 million from licensing and fee-for-service revenues. "While that figure is impressive, the real economic payback is from the sales and jobs generated in the licensee companies," says Denzil Doyle, Chairman of Doyletech Corporation.

By applying appropriate multipliers to the NRC-IIT revenues, the study esti-

mates that they translate into 1,215 cumulative person-years of employment – and cumulative sales in the receptor companies of more than \$240 million.

The Doyletech study also looked at companies created since 1990-1991 as a

result of the transfer of people and/or technology from NRC-IIT. In 2006-2007, 10 firms employed a total of 209 people and generated an estimated \$54.65 million in combined sales. "They pay corporate taxes and generate sales tax, while

the employees pay income tax, and this situation is not static – it goes on year after year," stresses NRC-IIT Director General Christian Couturier. ■

NRC technology supports Canada's indie musicians

A unique web portal used for rating and recommending music – inDiscover.net – is the first commercial web application of RACOFI Composer, a technology developed by NRC-IIT. The powerful RACOFI (Rule Applying Collaborative Filtering) Composer system takes what's known about a user and similar users to make tailored "word-of-mouth" recommendations automatically – sorting through over a million rated songs in a matter of seconds.

The inDiscover.net portal, which is licensed to Bell Canada and used on its MSN/Sympatico entertainment website, was created to help bring independent (or

"indie") music to new listeners by recommending songs based on their tastes. The portal also offers independent Canadian music artists access to an effective distribution channel and a wider audience base.

"This portal is a central part of the Sympatico/MSN music strategy," says Veronica Holmes, senior director for broadband innovation at Bell Sympatico/MSN. "Working with NRC, we've added new functionality and features that allow us to host and stream artists' music, and allow users to build play-lists and share them with friends." ■





A healthy boost for entrepreneurs

“Commercialization is a staged process ... you should be working on all four pillars – technical, regulatory, market and business – at the same time.”

Marlin Stangeland, Executive Director, BioAccess Commercialization Centre

Canadians are increasingly adding smart choices to their grocery carts such as calcium-enriched fruit juice, vitamin supplements and cereals with added fibre. The global market for healthy foods and natural health products is estimated at \$150 billion, and many Western Canadian companies are joining the boom. In the Saskatoon area alone, about 30 companies jostle for market share, generating revenues of nearly \$60 million.

But most start-ups falter in the early stages of commercialization, with as few as five percent surviving their first five years. The reason, according to companies themselves, is a deficiency of expertise in areas such as marketing, management, technology assessment, financing and strategies for navigating the regulatory jungle.

The BioAccess Commercialization Centre in Saskatoon, Saskatchewan was launched by NRC's Plants for Health and Wellness technology cluster initiative to give companies in the nutraceutical, functional food and natural health product industries a healthy start on the path to commercialization.

The Centre offers five programs that cover everything from finding your business “soul mate” (BioConnect) to delivering a winning pitch to potential investors (BioPitch). An online diagnostic tool, called BioMap, assesses a company based on four “pillars” – technical, regulatory, market and business – then delivers a “you-are-here” snapshot with guidance for each stage of product development. Another program, called BioIntel, connects firms with experts in competitive intelligence gathering, while BioData provides research, marketing and regulatory information.

“Our line-up of programs was developed in light of discussions with small and medium-sized companies to identify the most challenging barriers to growth and survival in this sector,” says Dr. Wilf Keller, Acting Director General of the NRC Plant Biotechnology Institute. “For every company that doesn't survive, Canada loses an opportuni-

ty to increase its presence in a growing sector, and Canadians miss out on the potential health benefits of these innovative new products.”

Today's healthy foods and natural health products hold the promise of everything from improved nutrition to protection against chronic disease. Brent Banda, President of Banda Marketing Group in Saskatoon, is working to commercialize a food bar that helps to treat conditions such as high blood pressure, high cholesterol and insulin resistance, all of which are risk factors for diabetes, heart disease and stroke.

The BioMap analysis told Banda that while his company was well ahead in the market and business pillars, he hadn't yet answered key questions about regulation and technology. “We were working through those issues, but we didn't know what questions to ask,” says Banda. “It really put the brakes on for us, and told us that we needed to address regulation and technology before we moved forward.”

The analysis also helped Banda to make a critical choice about how to market his product. “Based on information that we gathered working through the regulatory aspect of BioMap, we made a strategic decision to develop a functional food product rather than a natural health product,” he says.

Keeping companies on track throughout the commercialization process is one of the Centre's primary goals, according to Executive Director Marlin Stangeland. “The idea is that commercialization is a staged process ... you should be working on all four pillars – technical, regulatory, market and business – at the same time,” he says.

Stangeland adds that regulation – one of the biggest hurdles for health-related products – is an area where BioAccess offers industry-specific expertise. “In this industry in particular, you must have scientific evidence backing your product in order to claim that it has a health benefit,” he says. “The BioAccess Commercialization Centre can



What are functional foods?

Functional foods are foods consumed as part of a usual diet that have a known health benefit and/or reduce the risk of chronic disease beyond basic nutritional functions (e.g. calcium-enriched fruit juice).

What are nutraceuticals?

Nutraceuticals are products isolated or purified from foods that have a known health benefit or provide protection against chronic disease (e.g. omega-3 fatty acids, lycopene, carotene).

What are natural health products?

Natural health products include vitamins and minerals, herbal remedies, homeopathic medicines, traditional medicines, probiotics, and products like amino acids and essential fatty acids. They are available without a prescription and include nutraceuticals.

help companies ensure that their technology platform will have the scientific rigour to meet the regulations in the marketplace – regulations that may not even exist yet.”

The BioAccess Commercialization Centre is online at www.bioaccess.ca ■

New network – better buildings

Canadians spend about 90 percent of their time inside homes, offices, factories, commercial establishments and other buildings. So research on indoor environments affects everyone.

NRC has initiated a national network to link researchers involved in building and health-related disciplines. The new Canadian Building and Health Sciences Network will improve the health of Canadians by bringing together health scientists and building scientists to collaborate on improving the design, construction, operation and maintenance of the built environment.

“Through this network, researchers will share knowledge, develop research priorities, and form alliances to conduct focused research on specific health problems,” says Dr. Jennifer Veitch, the network coordinator and a senior research officer at the NRC Institute for Research in Construction. “This new community of researchers will support public policy, codes, standards and guidelines by providing sound scientific knowledge. For example, we may help to formulate checklists for healthful buildings,” she suggests.

To kickstart network activities, NRC will host an expert symposium next spring – the first formal face-to-face meeting of Canadian experts from relevant scientific and technical fields. These include medicine, occupational health, epidemiology, physiology, toxicology, chemistry, psychology, public health, architecture and all engineering disciplines.



Dr. Jennifer Veitch uses a luminance meter to measure light exposure. Recent research suggests that people may benefit from more light each day than they usually receive.

“The indoor environment may be one of the most fertile research areas in which to seek improvements to our overall health and well-being,” comments Dr. Veitch. “Chemical and physical pollution of indoor air, mould growth, noise and inadequate lighting may all diminish our well-being and contribute to disease.”

The idea for a new research network arose because focus groups of industry stakeholders said they wanted more information about the health consequences of different kinds of building conditions. According to Dr. Veitch, NRC decided to build this network because “we have a unique ability to be collaborative and we recognized our own limitations.”

“Our Indoor Environment Program is a relatively small unit with approximately 15 research officers, so unless we work together, we're not going to be able to solve all the possible problems,” she says. So far, her team has started to build relationships with key federal partners such as Health Canada, the Canadian Institutes of Health Research, and Canada Mortgage and Housing Corporation.

In terms of potential research priorities, “there are a number of areas we could focus on,” says Dr. Veitch. “Many people are familiar with issues related to indoor air quality. For example, are there building materials emissions that have bad consequences for health? What are the consequences of elevated levels of particulates of various sizes?”

“It's also important to recognize that there is much more to our physical environment than air,” she adds. “For example, we need to pay more attention to the kind of lighting conditions that people experience, both during the day and at night, because there is a growing body of science that has identified previously unknown effects.”

In addition, there are potential questions about the health consequences of noise exposure in buildings – especially transportation noise from airplanes and other vehicles. “In Canada, a lot of attention has been paid in industrial settings to limit noise exposure, but we have paid relatively little attention to non-industrial settings,” stresses Dr. Veitch.

For more information about the Network, visit: irc.nrc-cnrc.gc.ca/ie/health/cbhsn_e.html

Tune in to NRC's podcast to hear Canadian and international researchers discuss the impact of light on human health, www.nrc-cnrc.gc.ca/multimedia/podcasts/light_e.html ■



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To learn more about NRC services for business, visit our **Gateway for Business** at www.nrc-cnrc.gc.ca/business_e.html or call us toll free at **1-877-NRC-CNRC**





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NRC NewsLink
National Research
Council Canada
1200 Montreal Road
Ottawa, Ontario K1A 0R6
Canada

Fax: 613-998-8080
E-mail: info@nrc-cnrc.gc.ca
www.nrc-cnrc.gc.ca

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Recognized globally for research and innovation, NRC is a leader in the development of an innovative, knowledge-based economy for Canada through science and technology. NRC operates world-class research facilities as well as information, technology and innovation support networks coast to coast. Its outstanding people help turn ideas and knowledge into new products, processes and services, creating value for Canada. NRC works hand-in-hand with partners from industry, government and universities to help ignite the spark of innovation in communities across the land and to give Canadian companies a competitive edge in today's marketplace.

NRC award goes to diabetes researcher

A Canadian conducting diabetes research at Harvard Medical School is the next recipient of NRC's prestigious H.L. Holmes Award.

Dr. Jennifer Estall investigates the regulation of obesity and metabolic disease. Over the next two years, she will receive a total of \$198,000 to focus on the role of the PGC-1 alpha protein in the development and pathogenesis of diabetes mellitus.

In type 1 diabetes, the immune system destroys islets – essential cells within the pancreas that produce insulin. Dr. Estall proposes to investigate how the pancreas responds to an attack from the immune system at a genetic level.

This is “well-focused research of high relevance,” comments Dr. Michel Desrochers, Director

General of the NRC Biotechnology Research Institute and a member of the Holmes Award Selection Committee. He adds that Dr. Estall's application was “backed by strong publications in top journals.”

“Our lab previously discovered PGC-1 alpha, which regulates metabolic processes such as energy and heat production,” says Dr. Estall. “We also found that this protein can protect other human cells from the same kind of stress – the formation of reactive oxygen species such as free radicals – that occurs in the pancreas during an immune attack.”

“Through further research, we hope to gain a better understanding of how insulin-producing cells are destroyed in patients with type 1 diabetes and find out

whether PGC-1 alpha can protect the islets from damage,” she adds. “My ultimate hope is that this research will lead to new ways to prevent or treat diabetes in humans.”

Dr. Estall holds a Ph.D. in molecular biology from the University of Toronto, where she also completed her undergraduate studies in pharmacology. She

is now a postdoctoral fellow in the laboratory of Dr. Bruce Spiegelman, a professor of cell biology at Harvard Medical School and the Dana-Farber Cancer Institute in Massachusetts. Dr. Estall was presented with the Holmes Award on October 3 at the BioContact symposium in Québec. ■

The H.L. Holmes Award gives recipients the opportunity to conduct post-doctoral studies at world-renown graduate schools or research institutes. Projects are undertaken in the fields of chemistry, physics, biology or mathematics as they relate to medical and biological processes. The award was established in honour of the late Dr. R.H.L. Holmes, a chemist who bequeathed his estate to NRC, in recognition of NRC's commitment to promote research excellence.

To swim or not to swim?

If you fall into cold water while boating on a Canadian lake or river, should you swim to shore or stay with the boat? The answer was published in a recent issue of NRC's first journal devoted solely to human health: *Applied Physiology, Nutrition, and Metabolism*. The journal offers forward-thinking research on health topics of interest to policy makers, doctors, public health nurses and others working in the health care field.

A Canadian study published in the June 2007 issue showed that swimming to safety is sometimes the best option during cold water accidents, despite conventional advice to “stay with the boat.” This shift in thinking could affect public policy and is one of many fresh perspectives on health-related issues offered in

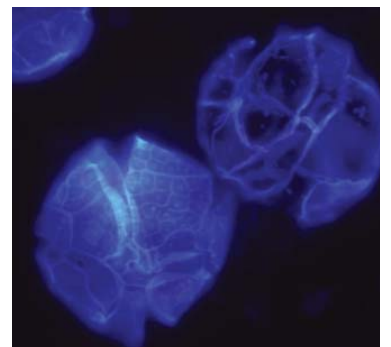
the journal. Another recent article showed that exercise lowers the risk of obesity-related illnesses such as heart disease and diabetes, even if obese patients don't lose much weight. Other topics have included nutritional deficiencies in the Canadian diet, gender differences in patterns of obesity, and the effects of exercise during pregnancy.

Applied Physiology, Nutrition, and Metabolism is published by NRC Research Press, the publishing arm of the NRC Canada Institute for Scientific and Technical Information. The journal is available from: pubs.nrc-cnrc.gc.ca/apnm ■

What's this?

This electron scanning microscope image shows cells of the dinoflagellate *Prorocentrum reticulatum*, a marine phytoplankton known to produce a biotoxin that is of concern to coastal states around the world.

Food and water safety are vital to the health of Canadians and our economy. So NRC researchers in Halifax, Nova Scotia develop and validate analytical methods to detect and identify toxins in seafood and plankton as well as fresh water sources used for drinking water and recreation.



NRC also prepares and distributes toxin calibration standards and reference materials for analysts and regulatory agencies in more than 40 countries. ■