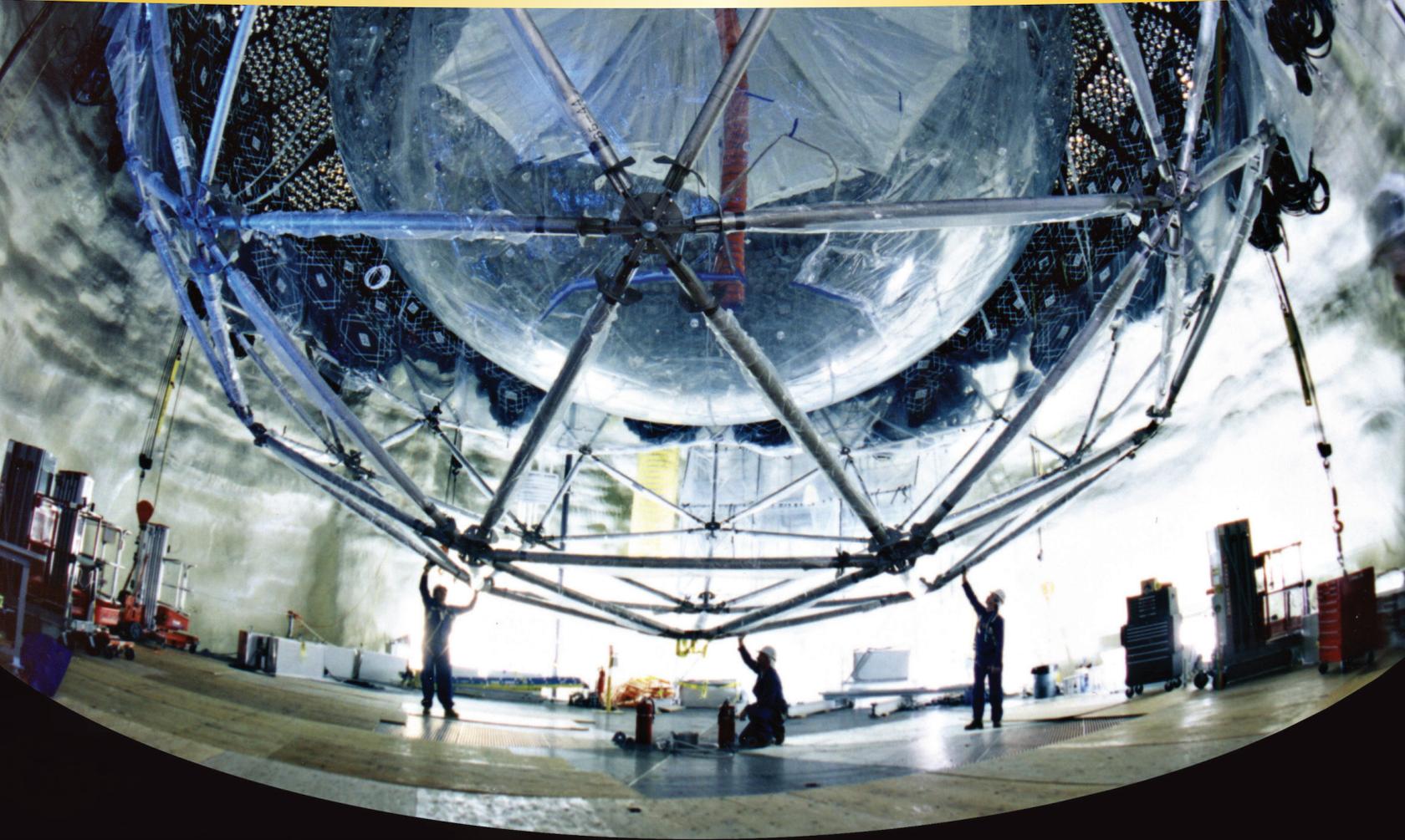


THE KEY

LAURENTIAN UNIVERSITY'S RESEARCH MAGAZINE

Curiosity • Creativity • Connectivity



SNOLAB – Pushing the boundaries of knowledge



Laurentian University
Université Laurentienne

THE FIRST WORD



Rui Wang, MD, PhD, FAHA
Vice-President of Research, Laurentian University

It is with great pleasure that I welcome you to the latest edition of *The Key*, Laurentian University's research magazine, a publication dedicated to celebrating our recent successes in research and innovation with our community, collaborators, funders and alumni world-wide.

The *key* to the future is research and innovation, which has been demonstrated by Laurentian's excellence over the last 5 decades. As Vice-President Research at Laurentian, I applaud the outstanding accomplishments of Laurentian's researchers and their teams. I am proud to be a part of a research community that is distinctively diverse, a reflection of our bilingual and tri-cultural mandate, and vibrantly dynamic, as the largest research and graduate training centre in Northeastern Ontario.

As we embark on the final stages of Laurentian's 2012-2017 strategic research plan, this issue of *The Key* highlights and celebrates the achievements of our researchers, students and research centres within each of Laurentian's strategic research themes. As you will discover, the impact of our research has been felt from deep underground mines around the world to the hallowed halls of the Royal Swedish Academy, from the communities and natural environment that surround us to the increasingly larger number of endangered species that require our protection.

Laurentian University is committed to creating new knowledge that can be disseminated broadly from our local community to a global audience, and we have earned national and international recognition for this commitment. According to Research Infosource, this past year Laurentian ranked second overall in research income from corporate research partnerships amongst primarily undergraduate universities in Canada. Way to go! Laurentian is on its march from good to great and the best is yet to come.

I hope that you enjoy reading this issue and learning about research and innovation at Laurentian University. The key is our determination. The key is our motivation. The key is in our hands!



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For more than a decade, we have been ranked among the top 40 universities in Canada in terms of research activity. This is a significant achievement for a university of our size.

AREAS OF RESEARCH

While research at the University encompasses many disciplines, Laurentian has identified five areas of strategic focus:

- ENVIRONMENT AND CONSERVATION
 - HEALTH AND WELLNESS
- SOCIAL AND CULTURAL RESEARCH AND CREATIVITY
- ENGINEERING, MINERAL AND MATERIALS SCIENCES
 - SUBATOMIC PHYSICS

THE KEY

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Vice-President Research
Dr. Rui Wang

Co-editors: Sherry Drysdale, Joanne Musico

Design: JoAnn Wohlberg

Contributors: Leigha Benford, Kyle Cormier, Evan Bate, Sherry Drysdale, Réjean Grenier, Jonathan Migneault, Joanne Musico, Kayla Perry, Gisèle Roberts

Translation: Jean-Yves Asselin, Linda Richard

Office of Research Services
Laurentian University
935 Ramsey Lake Road
Sudbury, Ontario P3E 2C6
705-675-1151, ext. 3944
research@laurentian.ca

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The Ethics of Conservation



From nuclear energy to medicine to the environment, science has always posed important ethical questions. In 2013, five Laurentian professors from diverse disciplines in the sciences and the humanities formed a research centre with ethics at its very core.

By Réjean Grenier

The professors, Dr. Albrecht Schulte-Hostedde, Dr. David Lesbarrères and Dr. Jacqueline Litzgus from the Department of Biology teamed up with Dr. Brett Buchanan and Dr. Gillian Crozier from the Department of Philosophy to create the Centre for Evolutionary Ecology and Ethical Conservation (CEEEC). It is a unique intersection of science and the humanities, with the motto “Seeking the philosophical and scientific answers to conservation questions.”

The key objectives of the Centre are to:

- Provide an intellectual and physical environment that will facilitate research excellence and the training of Highly Qualified Personnel
- Continue and grow the volume and quality of research in applied evolutionary ecology and conservation
- Contribute and develop critical analysis, ethical interpretation, conceptual clarity, and philosophical examination of applied research in evolutionary ecology and conservation
- Build collaborative partnerships with researchers from other academic, government and non-government institutions as well as industry to properly conceptualize and mitigate the effects of human activities on biodiversity loss using evolutionary perspectives
- Create synergies by sharing intellectual, human and research resources that will lead to enhanced research outcomes

The CEEEC’s annual report for 2014-2015 includes a list of 25 publications featuring the work of one or more of the Centre’s researchers. Readers can obtain a more complete list of publications by email.

Much of the Centre’s work is directed toward the public and focussed on increasing awareness. In 2013, the Centre launched its first event, the international symposium “Thinking Extinction: the Science and Philosophy of Endangered Species and Extinction.” The program included speakers on such topics as “Are Some Animals More Equal Than Others?” and “The Ethics of Revising Long Extinct Species,” and featured public lectures by Stuart Pimm of Duke University and author Margaret Atwood.



GILLIAN CROZIER

DAVID LESBARRÈRES

ALBRECHT SCHULTE-HOSTEDDE

CEEEC members have carried out studies on the effects of captivity on reproduction, the effectiveness of eco-passages along a busy highway, and the mysterious deaths of turtles on Manitoulin Island, to name a few. In all of its research, CEEEC works to spread knowledge and understanding beyond academe.

Working more closely with specialists from zoos and aquariums is an emerging project for the Centre. Dr. Schulte-Hostedde says CEEEC would like to create a training program for conservation biologists who work in a zoo or aquarium setting. Five Canadian zoos and aquariums and half a dozen universities are lined up to take part in this initiative. “We’re integrating an ethical program for the students,” says Dr. Schulte-Hostedde. “What that means is giving them the conceptual tools to make decisions about how to allocate resources, for example, for conservation programs.”

The CEEEC is also conducting an online survey asking ecologists to explain the values they use when designing field studies. The objective is to create a voluntary Code of Ethics for Canadian ecological researchers.

But that’s just the beginning. When asked where he sees the CEEEC in ten years, Dr. Schulte-Hostedde dreams of more members, scholarships for graduate students working in the Centre, a named-seminar series on conservation and its own space on campus.



BRETT BUCHANAN

THE SCHOOL OF THE ENVIRONMENT

THE CROSS-DISCIPLINARY ASPECTS of the Centre for Evolutionary Ecology and Ethical Conservation make it a unique centre of research.

The same cross-disciplinary approach is seen in Laurentian's School of the Environment, established in 2014.

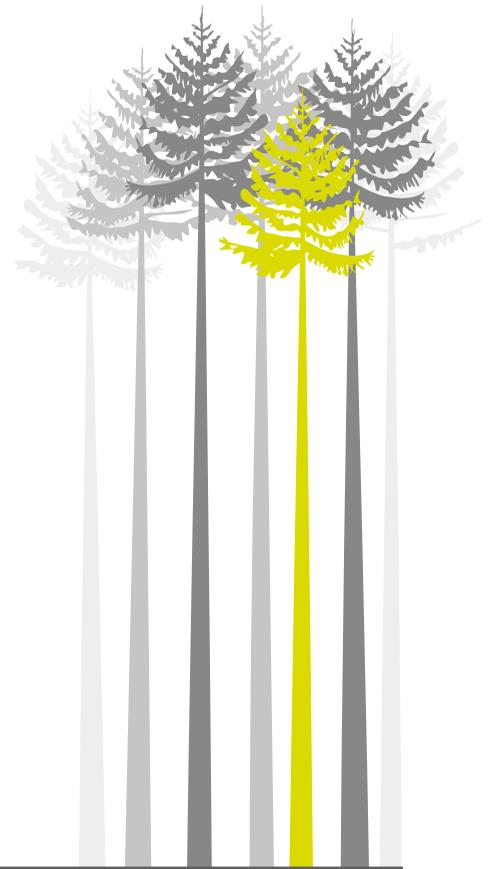
Laurentian University has long been known for its environmental teaching and research, with unique expertise and research capacity in such fields as stressed watershed systems, environment, culture and values, and applied evolutionary ecology. The School of the Environment builds on and complements these signature strengths, while leveraging expertise from affiliated disciplines on the campus.

The School currently has 13 faculty across five programs: Environmental Studies (BA); Environmental Science (BSc); Études de l'environnement (BA); Science Communications (Graduate Diploma); Archaeology (BA/BSc).

The School's cross-appointed faculty include professors in Philosophy, History, Biology, Indigenous Studies, Education, English and Economics.

Associate Professor of Philosophy, Dr. Brett Buchanan is founding Director of the School of the Environment. "Environmental issues really do touch every aspect of human existence," says Dr. Buchanan. "The School brings many disciplines together in the pursuit of environmental education and research, in order to enrich and broaden our students' perspectives, and with an aim towards environmental solutions. Essentially, we are acknowledging that studies around the environment involve the knowledge of other disciplines."

As it fulfills its mission, the School of the Environment continues to grow in its relationships with research centres and other partners, which include the Centre for Evolutionary Ecology and Ethical Conservation, the Vale Living with Lakes Centre, the Centre for Rural and Northern Health, the Laurentian University School of Architecture and the Goodman School of Mines.



KEEPING TRACK OF ENDANGERED SPECIES

LAURENTIAN IS NOT A BIG UNIVERSITY, but it has a sizable presence in an important national body that assesses and designates the wildlife species that could be in danger of disappearing from Canada.

The Committee on the Status of Endangered Wildlife in Canada, COSEWIC, is the national authority that establishes the list of species at risk in all regions of the country. From the plains bison, to the caribou, to the spotted turtle, more than 250 species are currently listed and monitored by COSEWIC. Species are listed according to category of risk; they can be considered of special concern, threatened, endangered, or extirpated (extinct in a particular region).

COSEWIC comprises ten national sub-committees of species specialists. These are academics and professional biologists who are tasked with reviewing the latest data to assess the risk level facing hundreds of species of mammals, birds, amphibians, reptiles, fish, insects and plants.

A Full Professor in Biology at Laurentian, Dr. Jacqueline Litzgus has served on COSEWIC's amphibians and reptiles specialist sub-committee since 2004. Dr. Litzgus is a herpetologist who has worked extensively on turtles and snakes in Ontario. Worldwide, turtles are under threat, and of the eight species of turtles found in Ontario, seven are considered to be at risk; Dr. Litzgus has worked on seven of these species. Habitat destruction and poaching are the primary threats to turtle populations. Dr. Litzgus has written two significant status reports for COSEWIC, on the spotted turtle and the wood turtle. Her work provides data to fill information gaps identified in recovery plans for species at risk reptiles, and tests hypotheses about the efficacy of recovery actions, thus informing government policy. Dr. Litzgus is also Director of Research for the Canadian Herpetological Society.

Dr. David Lesbarrères, Dean of Graduate Studies at Laurentian and an Associate Professor in the Department of Biology is also a member of the COSEWIC sub-committee for reptiles and amphibians. Dr. Lesbarrères'



JACQUELINE LITZGUS

research has focussed on amphibian populations in human-dominated landscapes, leading to either their adaptation or demise. Amphibians and reptiles face various threats in many regions of the country, including loss of habitat and infectious diseases, two important factors that Dr. Lesbarrères and his graduate students are investigating at Laurentian University. Dr. Lesbarrères is also head of GEARG, the Genetics and Ecology of Amphibians Research Group at Laurentian.

Dr. Albrecht Schulte-Hostedde, Canada Research Chair in Applied Evolutionary Ecology and Professor of Biology, was recently named to the COSEWIC species subcommittee on terrestrial mammals. His research focuses on evolutionary adaptation in mammals, and considers the impact of urbanization and invasive species on animal populations. Dr. Schulte-Hostedde's extensive work has produced findings on red squirrels, chipmunks, raccoons, and mink, both wild and farmed. He is Director of the Centre for Evolutionary Ecology and Ethical Conservation (CEEE), where Dr. Lesbarrères and Dr. Litzgus are also members. ▶◀



SANDRA DORMAN,
Director, Centre for
Research in Occupational
Safety and Health

CENTRE FOR RESEARCH IN OCCUPATIONAL SAFETY AND HEALTH (CROSH)

Fighting Fatigue in Fire-fighters

By Leigha Benford

In our well-connected and fast-paced society, it can seem like things are constantly moving. It's common to hear people comment on how tired they are, and it's also common to feel the result of a late night or a long workday. Increasingly chronic fatigue is connected to the workplace. Fatigue, as a concept, is more complicated than 'just feeling tired.' Many factors, including physical exertion, poor eating habits, reduced sleep quality/quantity; mental exhaustion and stress can all contribute to on-going feelings of fatigue. In the workplace, fatigue impacts worker health, safety and overall well-being.

Dr. Sandra Dorman, Director of the Centre for Research in Occupational Safety and Health (CROSH) and Dr. Céline Larivière, Director of the School of Human Kinetics, at Laurentian University, have an interest in fatigue and fatigue management. This interest has led to a unique collaboration between Drs. Dorman, Larivière and Aviation, Forest Fire and Emergency Services (AFFES), a division of the Ministry of Natural Resources & Forestry (MNR).

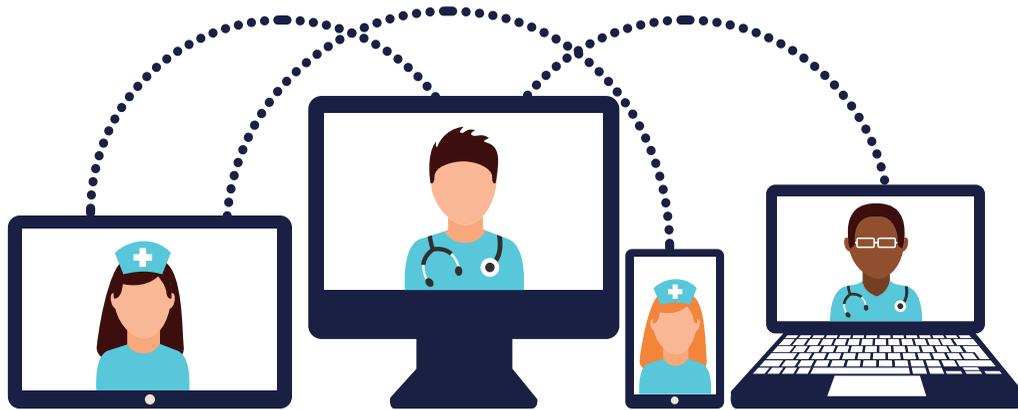
CROSH strives to create meaningful, collaborative partnerships between researchers, workers and workplaces and this project exemplifies this goal. "The MNR came to us and told us that they wanted to know more about fatigue in their seasonal FireRangers. We reviewed the literature, and it supports the idea that Canadian and American FireRangers have higher injury rates after longer deployments, and near the end of the fire season. CROSH had the expertise and resources to help, so we started looking for solutions together," explained Dr. Dorman.

FireRangers experience numerous factors that can contribute to fatigue, including: long work hours, varying sleep and nutrition patterns and the stress of being away from home while on deployment. The CROSH research team uses the term "Occupational Athlete" to describe this position, because the physical and mental demands of the job are similar to that of a professional athlete.

The first phase of this research began in the summer of 2014. CROSH researchers and graduate students in the Masters in Human Kinetics program at Laurentian University (Ayden Robertson and Zach McGillis) outfitted FireRangers with wearable technology, which they used during fire-fighting deployments that summer. This equipment monitored several factors known to contribute to fatigue, including: energy expenditure, calorie consumption and nutritional quality, sleep and time spent in recovery or stressed. Each FireRanger wore a heart-rate variability monitor (Zephyr™, BioHarness™ 3), an actisleep monitor and used an iPod Touch to create audio-video food intake logs. At the end of the summer, CROSH found that FireRangers expended more energy than they consumed, and had increased job stress and slept roughly six hours per night during deployments. In addition, key nutrient recommendations have been made to reduce fatigue related to food.

The next phase of this research begins this summer as Caleb Leduc, a doctoral student with Dr. Dorman, leads a wellness intervention trial, addressing issues uncovered in the first phase of research. Fire Management Headquarters across northwestern and northeastern Ontario will be asked to participate in this task-specific fitness training and psychosocial wellness program, which will be implemented throughout the fire season. The researchers and AFFES hope to show a reduction in injury rates in bases adopting the program. ❏

For more information about CROSH visit www.crosh.ca.



Better Health Delivery Means Better Health

By Réjean Grenier



DR. WAYNE WARRY

The first project title you'll see when you click on the Current Projects section of the Centre for Rural and Northern Health Research website (www.cranhr.ca) essentially defines the Centre's work: *Improving Health Equity for Northern Ontarians*. For reasons of geography and demography, accessing medical care can be more difficult for anyone living in a northern or rural community. Doctors can be scarce, specialists are often non-existent, and hospitals and clinics can

be hundreds of kilometres away. Coming up with ways to close the gaps between urban and rural health delivery is CRaNRH's goal.

Created in the mid-1990's, the Centre has completed 67 studies and is working on another 21, most aimed at improving the way health services are delivered in small communities. To do that work, CRaNRH can count on 17 staff members, including research assistants and associates, as well as some 25 investigators. The latter come from different fields: from medicine and nursing, but also from medical anthropology, human kinetics, Indigenous studies, geography, psychology, and sociology. The Centre's studies have yielded a huge body of work, from journal articles and books to conference presentations and online reports. One study actually produced a 52-minute documentary titled *Lost in the Woods: Traversing Rural Children's Mental Health Care* by Dr. Hoi Cheu of Laurentian's Film Studies Program. It can be downloaded from the CRaNRH website.

Some researchers have studied certain diseases but according to the Centre's director, Dr. Wayne Warry, that is not CRaNRH's focus. "Our research, by and large, is what's known as health systems research. So our investigators do research on specific illnesses – for example my partner, Dr. Kristen

Jacklin, at the Northern Ontario School of Medicine (NOSM) and I do work concerning dementia in Aboriginal communities – but the Centre is focused on how people are interacting with the health system and on ways, via policy and practice, to improve the health care system."

Dr. Warry says this work benefits all Ontarians. He argues that improving the system means "that people have better access to care, better quality of care, and taxpayers save money (by) improving health efficiencies." One of the more recent improvements in the delivery of health care is telemedicine. Dr. Warry: "What we're trying to do is map how telemedicine is utilized across the North but also asking what is the quality of care delivered through telemedicine. We're demonstrating that patients can have remote interactions with physicians, clinicians and specialized services and still get quality of care." Dr. Warry says telemedicine is a perfect example of how we can improve care while also reducing costs.

Dr. Warry points to the creation of the NOSM in Sudbury and Thunder Bay as another major improvement to the delivery of health care in the North. He says the Centre's research shows many graduates remain in the North, thereby "increasing access to physician services in smaller, rural towns."

This year CRaNRH will embark on a new adventure called the Strategy for Patient-Oriented Research (SPOR). It's a broad national initiative that aims to engage patients as partners, improving patient outcomes while focussing on priorities identified by patients. Dr. Warry says that SPOR "is trying to increase the participation and guidance of patients in health systems," and he believes it represents a major shift in health systems research.

Whatever the subject, the angle, or the shift, it is clear that CRaNRH's research teams will continue to improve health care in remote, rural and northern regions, by listening to people and examining the services they receive. 



Far left: Paul Ross, great-great-great-grandfather of Pierrot Ross-Tremblay, in Essipit Innu First Nation circa 1910.

The antidote to amnesia: stories and identity

By Evan Bate

If someone has a diamond, and you make them believe they have nothing, they will trade it. When you internalize the idea that you have no history, you begin to believe that you have no rights, no identity. *You give yourself away.*



DR. PIERROT
ROSS-TREMBLAY

DR. PIERROT ROSS-TREMBLAY, Chair of the Department of Sociology at Laurentian University and the first francophone Aboriginal professor appointed in the Faculty of Arts, is describing the phenomenon of “cultural amnesia”. This erasure of identity and personal history brought on through policies of colonialism and residential schooling is, in his view, one of the most serious impediments to solving many of the challenges facing First Peoples in Canada.

“The production of amnesia, generated by command to forget, is at the heart of colonialism and domination,” he says. “If someone believes that he has no history, and does not know his relation to the land, he is more likely to be alienated.”

Seven years ago, while studying at the University of Essex in England, Dr. Ross-Tremblay returned to his home community of Essipit First Nation to write his doctoral thesis. He became acutely aware of the impacts that trauma can have on the sense of self and one’s role in bridging the past and the present. He observed firsthand how seminal events in the community’s history were largely unknown to younger generations, as the lingering effects of 150 years of “forgetting” had seemingly damaged a rich tradition of oral storytelling.

“The goal of the residential schools was to erase all traces of Indigenous identity through conditioning people to associate indigenous culture with humiliation and suffering. What that does collectively is create a dam. There was a conditioning to forget.”

He documented his experience, tracing the genealogy of cultural discontinuity, the production of amnesia among his people. The results will be published in a book – *You Shall Forget: Indigenous Rights, Resistance and the Production Cultural Amnesia in Canada* – to be released in 2016.

Dr. Ross-Tremblay continues to focus his research efforts on the reclamation of memory and identity as a means of collective empowerment and transformation. One of the most exciting of his projects is a collaboration with the Museum of the Person in São Paulo, Brazil. This work has led to the creation of a new Indigenous Research Lab at Laurentian, where people’s life stories are recorded and turned into historical materials to be disseminated.

“Amnesia is a phenomenon that was consciously produced, which means it’s something that can be undone,” says Dr. Ross-Tremblay. “For that to happen, you need to regain your own memory. When people tell their story it becomes a memory. When it is shared with others, when it is socialized, it becomes history. That’s when real change can occur.”

Working closely with Karen Worcman, a well-known Brazilian linguist and historian, Dr. Ross-Tremblay leads a research unit that is recording the life stories and experiences of Indigenous academics to document their place within academia. The unit has also begun a long-term project aimed at recording residential school survivors, with a focus on their experiences of resilience and their strategies for dealing with traumatic memories.

Similar work has been done with the elderly francophone and Métis. Their stories have been sought out as a way of exploring the health benefits of positive nostalgia and accessing pleasant childhood memories.

“There is a need to listen to and speak with people who are marginalized and invisible in Northern Ontario, including the elderly,” says Dr. Ross-Tremblay. “We live in a society that devalues what is past – we’re always

moving forward at a rapid pace. When they tell their stories – the first time they have ever been asked to do so, in many cases – they can access good memories, leave things behind and find meaning in their lives. It is a way to protect dignity as well. The benefits are direct. When we hear the story of an elderly person, when we are able to see them at seventeen, to hear the story of their first love for example, there is a respect that evolves.”

All recordings produced at the lab are being compiled into a larger database of stories and materials that will be accessible to the public. Ultimately, these recordings will be used to inform educational curricula, satisfy the need for individuals and communities to reclaim their agency by telling their personal stories and be heard. “What we’re doing with the lab is creating archives. We’re just starting out, but in 30 years it will be a jewel – a real treasure.”

Another area of interest for Dr. Ross-Tremblay is the revitalisation of Indigenous Laws in Canada – he is a co-researcher in a Social Sciences and Humanities Research Council-funded international project that assesses the relationship between State Laws and Indigenous Laws and strategies for the revalidation of Indigenous Legal Traditions in Canada. “For this specific project, I work closely with the Indigenous Law Research Unit of the University of Victoria led by Dr. Val Napoleon and Hadley Friedland. What they are doing create great hope for the revitalisation of our legal systems as a form of reparation.”

When people tell their story it becomes a memory. When it is shared with others, when it is socialized, it becomes history. That’s when real change can occur.

Dr. Ross-Tremblay is also leading the development of an Indigenous Institute at the Faculty of Arts to unify Indigenous faculty around common issues, offer opportunities to grad students and provide space for community stakeholders to gather and participate in knowledge exchange and problem-solving. The ultimate goal is to turn knowledge into action and increased indigenous capacitation in research. By providing a space for people to gather, share ideas and learn from each other, the community’s capacity to do its own investigating and problem solving is increased. “It may seem simple,” says Dr. Ross-Tremblay, “but Indigenous people have been excluded from the education system in the past, and there is still a huge gap in research.”

“Part of what excites me most about Laurentian is the critical mass of Indigenous faculty we have. This is a historic moment. This is the potential for social innovation and new ways of connecting academia to the public that exists at Laurentian right now. We need those spaces where the issues as defined by the people can be on the table. And now we’re making them.”

The spaces Dr. Ross-Tremblay is working to create, the stories he is capturing, and the voices he is making heard – all are helping to reshape identities, and to create a more just and inclusive future. The research is vitally important, but confronting a repressed past isn’t an easy process.

“Research produces uncertainty because it is a search for truth – showing people what they don’t necessarily want to see; what is invisible. As a researcher, you don’t just do what you like. You do what is needed.”

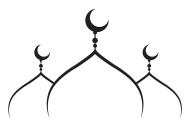
“The truth is often painful,” he admits, “but it is part of the remedy.” 

THE MEANING OF SACRED SPACE:

Mosque architecture & design in Canada



Al Rashid Mosque in Edmonton was the first mosque built in Canada (1938).



“...WE SEE A TREND TOWARD CREATING SPACES THAT ELIMINATE SEGREGATION AND ENCOURAGE PARTICIPATION.”

By Sherry Drysdale

Across Canada, in cities large and small, the distinctive silhouette of the mosque serves as a beacon to Muslim communities, often adding a graceful note to local skylines. The Muslim house of worship is seen both in its traditional style, elegant minarets reaching skyward, or adapted to Canadian landscapes, using modern shapes and local materials, sometimes with squared minarets and modest domes.

There are more than 140 mosques and Islamic centres in Canada today, in all regions of the country. But is there a particularly “Canadian” mosque design? What do Canadian mosques tell us about the communities they serve, and how do the men and women of those communities use these places of worship?

These are some of the questions that Tammy Gaber is exploring in a research project funded by SSHRC, Canada’s Social Sciences and Humanities Research Council. Dr. Gaber is Associate Professor at the Laurentian University School of Architecture, currently teaching Architectural Design Studio and Sacred Spaces. Her research project is entitled *Beyond the Divide: A Century of Canadian Mosque Design and Gender Allocations*.

Her research requires thousands of kilometers of travel across Canada. Dr. Gaber will visit as many as 40 mosques, while spending time with members of local Muslim communities. In the early stages of her research, Dr. Gaber has explored mosques from Regina to Lac LaBiche, and from Vancouver to Inuvik, which is home to the northernmost mosque in the western hemisphere.



DR. TAMMY GABER



The Midnight Sun Mosque opened in Inuvik in 2010. It was built in Winnipeg, then shipped more than 4,000 km overland.

Inuvik's "Midnight Sun" mosque is a uniquely Canadian story. Because of the high cost of shipping construction materials to the far north, the Inuvik mosque was actually built in Winnipeg, and then shipped by barge and by road more than 4000 kilometers to the small town on the Mackenzie Delta. Opened in 2010, the mosque serves a Muslim community of about 100 people in Inuvik. It also houses a community food bank that is funded by charitable donations.

The country's very first mosque also has a distinctly Canadian flavour. Built in Edmonton in 1938, the Al-Rashid mosque was funded by donations from locals of all faiths, including Muslims, Jews and Christians on land donated by the local government. A red brick gabled building, the mosque was designed by a Ukrainian-Canadian builder and was influenced by the design of Orthodox churches, with onion domes on the two minarets, and crescents mounted on top. The original building is now preserved as a historical site in Fort Edmonton Park.

Dr. Gaber is interested in the largely unmapped story of mosque design in Canada. "These structures have come to reflect their local communities and geography," she says. "We can see particular East Coast and West Coast architectural language that has developed over the decades; we see these buildings adapted to local needs and conditions."

Another aspect of her research involves the social use of the Canadian mosque.

"Especially in the smaller towns, we see that mosques may act as resource centres for the community. They host food banks, they may provide meeting places for groups, for workshops and classes. It's this intersection of house

of worship and community resource that is quite fascinating to me," she says. The question of how space is allocated between men and women in mosques is also central to Dr. Gaber's investigation. "We see a growing trend to gender mosque spaces, to heighten differences in spatial allocations to each gender. There is an unfolding conversation underway within the Islamic communities, a conversation about gender roles and shared space, and we see a trend toward creating spaces that eliminate segregation and encourage participation," she says. "In this way, the mosques emerge as places of peaceful co-existence and pro-active centres within Canadian society."

Dr. Gaber holds Bachelor degrees in Environmental Studies and in Architecture from the University of Waterloo. She earned her Masters of Architectural Engineering and Doctorate of Philosophy from Cairo University. She previously taught design, theory and building sciences at the University of Waterloo, British University in Egypt and the American University of Cairo.

Dr. Gaber's research on Canadian mosque architecture will be disseminated academically in peer-reviewed journals and symposia. It will also be disseminated in Canada's Muslim communities through collaboration with the Canadian Council of Muslim Women by linking the research blog to the CCMW website and with a colloquium and photographic exhibition planned for the CCMW's 'Women Who Inspire' event in 2017.

Dr. Gaber hopes the conversation will reach a wide audience, informing and improving equity and inclusive design strategies for Canadian mosque architecture and recognizing the contribution Muslims have made to the built landscape of the country in the past century. ❧

SNOLAB – From Darkness to Light

Pushing the boundaries of knowledge

By Jonathan Migneault

If you were to gather the world's leading astrophysicists in a room and ask them to jot down the globe's greatest centres of innovation in their field, Sudbury's SNOLAB would no doubt top many lists.

What was already obvious to world researchers became equally clear to the public when Art McDonald, director of the Sudbury Neutrino Laboratory (SNO), shared the 2015 Nobel Prize in Physics with Japanese physicist Takaaki Kajita for "the discovery of neutrino oscillations, which demonstrated neutrinos have mass."

McDonald later described the honour, and the boisterous experience that followed – becoming the scientific world's equivalent to a rock star – as "like a fairy tale."

After the Nobel win came the prestigious Breakthrough Prize in Fundamental Physics awarded to the SNO collaboration, bringing more recognition and a share in a \$3 million prize. "I'm hoping these awards, the Nobel Prize and the Breakthrough Prize, will inspire young people to consider science as a career," McDonald said.

Long before these accolades, McDonald worked with a group of dedicated colleagues – including several members of Laurentian University's Department of Physics – to build a laboratory that would expand humanity's understanding of the universe by giant leaps.

SNO's foundations predate McDonald's involvement with the project. Physicists Herb Chen from the University of California, Irvine and George Ewan, from Queen's University,



presented their vision of an underground fundamental physics laboratory in Canada in 1984.

Inco's Creighton Mine in Lively, west of Sudbury, was identified as an ideal location for the lab. McDonald joined the project in 1988, and in 1990 the Canadian government approved the lab's construction. The lab would be built at the mine's 6,800-foot level, where two kilometres of solid rock overhead would protect its delicate experiments from outside radiation and cosmic rays. It took researchers eight years to build the ambitious SNO experiment, which ran from 1998 to 2006.

McDonald's goal, along with that of his research team, was to solve the "solar neutrino problem." The majority of neutrinos – subatomic particles surrounding the Earth – are created in the Sun's core, through nuclear reactions. Physicists could not account for all the neutrinos coming from the Sun by the time the particles reached the Earth. Something didn't add up.

By observing neutrinos in 1,000 tonnes of heavy water, away from the interference of cosmic rays, McDonald and his team discovered that many neutrinos from the Sun change "flavours" by the time they reach the Earth. Those new flavours accounted for the previously "lost" neutrinos that seemed to have disappeared.

The subatomic particles' ability to transform through oscillations proved that they indeed had mass. That discovery was a major scientific breakthrough, and would earn McDonald the Nobel Prize.

While later phases of the SNO experiment were still underway, its success led to an expansion called SNOLAB. The project was jointly proposed by Laurentian University, Carleton University, Queen's University, the University of British Columbia, the University of Guelph and the Université de Montréal.

SNO already occupied 1,860 square metres on Creighton Mine's 6,800-foot level, but the expansion would be nearly three times larger. Excavation began in 2004, and in 2012, thanks to the support of an international joint venture program, including the Canada Foundation for Innovation (CFI), the Northern Ontario Heritage Fund Corporation, the Ontario Research Fund, Vale and FEDNOR, the 5,350-square-metre expansion was completed. The lab now includes 10 projects that are either operational or in development.

Today SNOLAB epitomizes international collaboration, with 14 countries engaged in research at the site, and more than 500 people attached to the various projects. "We have Laurentian researchers working on most of the experiments we host here," said SNOLAB director Nigel Smith. "There are a lot of interlinks between SNOLAB and Laurentian University at many levels."

Rui Wang, Laurentian's vice-president of research, chairs the SNOLAB council, and Laurentian faculty members continue research meant to expand our basic understanding of the universe.

Christine Kraus, the Canada Research Chair in Particle Astrophysics, is one of the lead researchers in the SNO+ experiment. The experiment, expected to begin in 2017, will expand on the original SNO experiment's findings. While SNO solved the solar neutrino problem, and found the particles have mass due to their oscillations, it did not determine what that mass was.

With SNO+ Kraus and her colleagues hope to observe a hypothetical process called neutrinoless double beta decay. The process – which has never been observed – is a type of radioactive decay in which two neutrons convert to two protons and two electrons. Neutrinos would be involved in this reaction,



Top from Left: Dr. Jacques Farine, Dr. Clarence Virtue, Dr. Christine Kraus, Dr. Doug Hallman.
Bottom right: Dr. Art McDonald

but would never leave the nucleus of the atom, the small dense centre made up of neutrons and protons. In a neutrinoless double beta decay, all the energy would go to the electrons – which is what SNO+ would detect. The neutrinos would be called Majorana particles in this case, and would be their own anti-particles. “We’re interested in that because the neutrino being its own anti-particle typically means that we’re violating a symmetry,” Kraus said. “Whenever we violate a symmetry something really interesting happens.”

Violating that symmetry means going beyond the Standard Model – a unified theory of all interactions except gravity as they are understood today. The Standard Model does not account for neutrinos having mass.

Observing neutrinoless double beta decay – if it exists – would allow researchers to measure neutrinos’ mass, and would be the first process observed in nature that doesn’t respect Lepton

number conservation – essentially breaking the symmetry observed in all other particle reactions. The SNO+ detector will use a 12-metre diameter acrylic sphere filled with around 800 tonnes of liquid scintillator which will float in a water bath. Liquid scintillator is an organic liquid that gives off light when charged particles pass through it. SNO+ will detect neutrinos when they interact with electrons and nuclei in the detector to produce charged particles which, in turn, create light as they pass through the scintillator.

Laurentian researcher Jacques Farine also hopes to observe neutrinoless double beta decay with the Enriched Xenon Observatory (EXO) experiment. But instead of the liquid scintillator used in the SNO+ experiment to detect solar neutrinos, EXO uses an isotope of the noble gas xenon, called xenon-136, and would measure the neutrinoless double beta decay from the xenon.

EXO has produced results from 2011 to 2013 that have established the best limit on neutrino mass, and the most precise measurement of a double neutrino decay rate.

The experiment’s next phase, called nEXO, could be a future tenant of a large open area in SNOLAB called the cryopit. While nEXO would cost around \$150 million to build and operate, Farine said the positive results from EXO have put the experiment in a good position to receive support from various funding agencies around the world.

Several SNOLAB experiments focus on neutrino research, but the search for dark matter is also a preoccupation for many SNOLAB scientists. Ubi Whichoski, chair of Laurentian’s Department of Physics, has dedicated much of his SNOLAB research to the PICO experiment, and its predecessor, PICASSO. PICO uses a superheated Freon liquid to directly detect dark matter particles, which are theorized to make up around 27 per cent of all energy in the universe. In comparison, the ordinary matter we interact with every day, which also forms the stars, planets and all observable elements in the universe, makes up only around five per cent of the energy in the universe. Scientists have determined that if one were to combine all the observable matter in the universe, it would not be enough to create the seeds that lead to the Big Bang, and the formation of the universe. Dark matter is supposed to fill that gap.

The gravitational field from the combined mass of dark matter particles is also theorized to account for the movement of galaxies, and the “glue” that holds them together. Despite its abundance, dark matter has never been directly observed. There are many experiments around the world racing to make that discovery and earn the Nobel Prize that could come with it.

Because the liquid in the PICO experiment is heated many degrees past its boiling point, even the smallest amount of energy could set it off, and turn the liquid to gas. Underground, the experiment can shield itself from most cosmic rays that would set off the superheated liquid at surface. Using complex mathematical models, researchers can determine whether known particles have interacted with the liquid, creating gas bubbles.

Through a process of elimination, if an unknown particle creates a gas bubble it would have to be dark matter. Such a discovery would immediately open the door to further research on one of the largest sources of all known energy in the universe.

As with SNOLAB’s other fundamental research experiments, results from PICO will help expand our understanding of the universe and could lead to unforeseen advancements in technology. ▶◀



DR. MING CAI

Professor's modified rock bolt design contributes to mining safety

Nearly four years in the making, an undergraduate project from professor Ming Cai's course has produced a technology innovation that aims to improve mining safety and rock stabilization.

By Kayla Perry

Professor Ming Cai's impressive career spans over 25 years of instructing, researching, and working in the engineering industry. Before joining Laurentian in 2009 as a faculty member, Dr. Cai achieved a B.A.Sc. and M.A.Sc. from Tsinghua University in China, and a Ph.D. from the University of Tokyo.

A full professor in Laurentian's School of Engineering, Dr. Cai is also a registered professional engineer in Ontario, and a Research Chair in Geomechanics.

In recent years, he has spent a great deal of time researching rock. His interests lie in topics including rock mass strength, rock mass classification, tunnelling, rock support, and computational geomechanics.

Naturally, his interest in rock mechanics and rock engineering research has translated into some of the courses he has taught at Laurentian, and it was within one of his undergraduate courses that Dr. Cai first began developing the design for a new rock bolt, titled Superbolt.

UNIQUE DESIGN – Rock bolts are conventional measures that are used to support loose rock in excavated mining tunnels. Dr. Cai says that an ideal tunnel excavated in massive and low stress ground will be stable, but there are normally stress-induced fractures, joint discontinuities and gravitational effects that require ground support measures to stabilize the tunnel and create a safe environment.

While installing rock bolts, a slender hole is drilled into the rock wall of a mine's tunnel. The bolt is then inserted into the rock wall, and is secured in place with resin. Often, the rock bolts also secure rows of wire mesh that prevent smaller, loose pieces of rock from falling.

A version of Dr. Cai's Superbolt design features a MCB33 modified cone bolt with a resin-mixing blade, a cone, a reinforcing/de-bonding agent (a corrugated steel pipe), a dome nut, and a dome plate. The de-bonding agent of the steel pipe, coupled with its strength and rigidity, allows for further rock reinforcement: while the Superbolt is physically strong, it can also effectively absorb dynamic energy that is released during a rockburst because of the unique design.

"The bolt has both reinforcing and yielding support capacities, and it can be installed quickly. Thus, it offers potential savings for mining companies to develop mines faster and have effective support with this bolt," he says.

Dr. Cai says the development of more effective rock bolts, like Superbolt, can improve mine safety, especially in Sudbury and other regions with deep mines.

"In shallow ground, there is often loose rock failure, which is easy to secure with conventional rock support technology. In the Sudbury basin, and in Northern Ontario, however, the mines go deeper and deeper underground. There, the ground stress increases due to depth, and it is also affected by

mining excavation. This stress can fracture a rock in an unexpected way, and the support in the mine can fail. If this happens, it can cause a rockburst, which is very dangerous."

DEVELOPED IN AN UNDERGRADUATE CLASS – Dr. Cai first recognized the design for this new type of bolt while working with students in his Mining Engineering Design Project course in 2012. He assigned a design project to students working in groups of four, and listed specific criteria for the design of a new yielding rock bolt, including static strength, yielding capacity, ease of manufacture and installation, and cost.

Students took up the design challenge. They began with several different designs, and, in a brainstorming session one afternoon in class, alumnus Ian Van Eyk remembers Dr. Cai noticed something new. "We were trying to design a bolt which would still be effective in supporting the rock, even after a rockburst hits. We decided to brainstorm several different designs for a dynamic bolt that would be resistant to shear forces, or forces going perpendicular to the rock bolt. Professor Cai encouraged us to work on refining it." Van Eyk says his professor was always helpful. "He gave us the tools to achieve our goals in the course, and if we ever veered off course he'd help put us back on track." In his current position as an Engineering Planner at Vale, Van Eyk says the rock bolt project in the Mining Engineering Design Project course was a very helpful experience in his engineering education.

Of the four students who worked on the rock bolt's initial development, Alexander Watt, Ukelauchi Tabele, and Ian Van Eyk all graduated in 2012 from the Mining Engineering program and began working for Vale; fellow grad Kevin Pan has been employed at various mining companies and currently works with DMC Mining Services.

Watt also remembers working on the rock bolt project with Dr. Cai and his classmates over the duration of the semester. He says it took self-discipline to finish the project, while balancing full course loads. After his students graduated, Dr. Cai continued to refine the design.

Patenting of the Superbolt was initiated in 2012 when Dr. Cai first disclosed the new design to Laurentian University. Since then the university has pursued its commercialization and patents are pending in Canada and Chile. All four students are listed as co-inventors. Dr. Cai says it may take a few more years for the patents to be issued; it is a lengthy process. All four of the undergraduate students who worked on the project with Dr. Cai were active in the patent application process. Dr. Cai has also secured NSERC CRD funding to develop prototypes.

"Hopefully, this year we'll be able to prove to the industry that this bolt is something that is useful. I'm clearly very passionate about it," says Dr. Cai. Currently, the Superbolt design is being prototyped in collaboration with Sudbury's Mansour Mining Technologies Inc. One day, it could be making underground workplaces safer world-wide. ❏



Laurentian Mining Innovation and Technology
Innovation et technologie minières à la Laurentienne



VIC PAKALNIS

Sudbury is one of the world's largest mining education, service and research clusters. Massive deposits of nickel, copper and platinum group elements have made Sudbury synonymous with hard-rock mining and Laurentian University is part of this legacy.

IN FEBRUARY 2016, LAURENTIAN UNIVERSITY announced the establishment of the new Mining Innovation and Technology research initiative, LMIT, which will synchronize and optimize research and innovation activities in all aspects of mining at Laurentian University.

This new initiative will coordinate and promote all mining-related research conducted at the University's research centres such as the Mineral Exploration Research Centre (MERC), the Centre for Research in Occupational Safety and Health (CROSH), the Vale Living with Lakes Centre (VLWLC) and the Mining Innovation Rehabilitation and Applied Research Corporation (MIRARCO).

Laurentian University now offers a one-stop approach to its mining research, unified under LMIT. This integration and synchronization will help to generate new opportunities for mining related research, while coordinating the University's external relationships related to mining research and innovation.

President and CEO of MIRARCO, Vic Pakalnis has been appointed Associate Vice-President of LMIT. "We are sharpening our focus on mining research while solidifying Laurentian's position as a pre-eminent mining research leader in Canada," said Mr. Pakalnis.

"The outstanding talent and efforts of Laurentian's research teams and the strategically prioritized approach have positioned Laurentian as a global leader in mineral exploration and mining research and innovation. We are excited by the launch of LMIT, to better support the excellence of our mining research," said Dr. Rui Wang, Vice-President of Research at Laurentian University. "The establishment of LMIT will also allow Laurentian to more effectively work with our community and industry partners as well as align with the recently renewed Ontario's Mineral Development Strategy (2015)." 

Upping our Game: Laurentian's drive for research excellence

By Kayla Perry

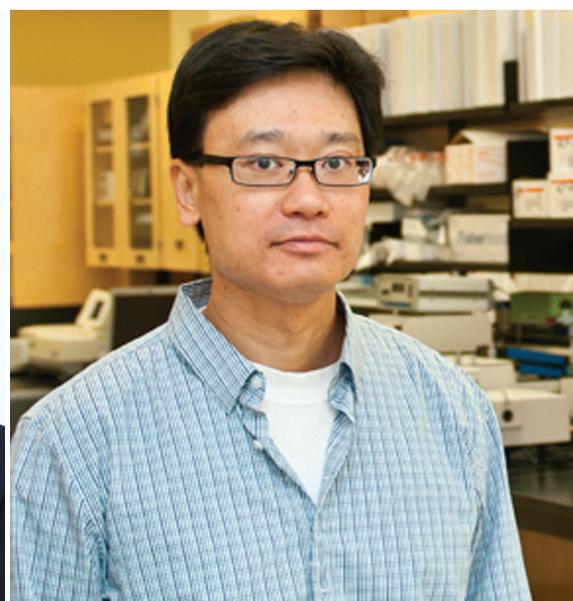
Laurentian has appointed three faculty members as Tri-Council Leaders in the agencies of the Natural Sciences and Engineering Research Council (NSERC), the Social Sciences and Humanities Research Council (SSHRC), and the Canadian Institutes of Health Research (CIHR). The Leaders will act as delegates for the university within their respective disciplines, while continuing to further their own individual research.



Thomas Merritt, NSERC



Gillian Crozier, SSHRC



T.C. Tai, CIHR

Laurentian's three Tri-Council Leaders explain their focuses on bringing research funding to the university in the natural science, social science and health research sectors.

Thomas Merritt joined Laurentian as a faculty member in 2006. Along with his appointment as NSERC Leader, which came in fall 2015, Merritt is also a Tier 2 Canada Research Chair in Genomic and Bioinformatics, and a Full Professor.

He describes the Tri-Council as being tasked with advocating the importance of multi-disciplinary research to the Canadian government, debating how much funding should be invested in each field of research, and then finding a way to effectively distribute the funds that are given to each council.

"There is a limited amount of dollars out there. One job that the NSERC administration has is to identify where the money is best spent, at that moment," says Dr. Merritt, who says that one of the important, and impressive, things about the Tri-Council is the comprehensive peer review involved in awarding of the grants.

He stresses that gaining research funding is essential to training the next generation of scientists, and expanding Laurentian's role as an institution that fosters research excellence. He also applauds Laurentian's status as a primarily undergraduate university which still

receives substantial research funding and supports a vibrant research community.

"There's always been a strong research presence at Laurentian, and it has been increasing over the past ten years. We have fantastic instructors who are also fantastic researchers, and that combination is something really valuable to students."

He hopes to continually grow this research excellence by using his experience writing and reviewing grant applications to assist other Laurentian faculty members in gaining more research funding.

One aspect of Dr. Merritt's current research uses fruit flies to understand the physiology of underground mining. Flies and humans share over 60 percent of their genes and have the same fundamental biochemistry. By taking the flies to SNOLAB, two kilometers underground, Dr. Merritt is able to study how the metabolism of the flies is affected by the high-pressure, deep underground environment.

"We're trying to understand which changes in the metabolic network after going underground are good and which are bad – and how we can promote the good changes and block the bad ones."

When discussing her role as SSHRC Leader, Gillian Crozier praises Dr. Rui Wang, who was unanimously appointed by the Board of Governors as Laurentian's Vice President, Research, in 2014.

Dr. Crozier says that, Dr. Wang has the "right idea" about bringing funding research to the university – for these Tri-Council Leader positions, Dr. Wang opted to appoint professors who have experience applying for and researching grants.

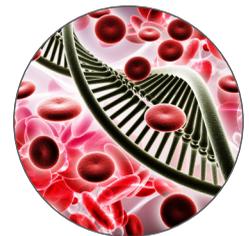
Dr. Crozier notes that her role as SSHRC Leader goes beyond advocating for Laurentian within the council: she must also "act as a liaison with SSHRC leaders, communicate what changes are happening in the council, and disseminate that information to the university."

She also communicates with fellow Laurentian faculty and researchers to ensure they are aware of what grants are available to them, and may be most relevant to their research.

While Crozier concedes that there is "not a huge amount" of funding available through SSHRC, she notes that the grants that are available allow for student scholarships, and also allow faculty members to fairly compensate their student researchers.

Dr. Crozier joined Laurentian in 2011, and serves as a Tier 2 Canada Research Chair in Environment, Culture and Values. Her current research focuses on the philosophy of evolutionary biology and cultural evolution. She also studies bioethics, and is researching how claims surrounding animal research.

"We have fantastic instructors who are also fantastic researchers at this university, and that's something really valuable to students."



T. C. Tai was appointed as CIHR Leader for Laurentian in December 2015, but he has a long-standing interest in CIHR and the funding it awards to researchers. Throughout his career as a researcher, he has been funded by this agency.

Dr. Tai joined the Northern Ontario Medical School (NOSM) in 2004, after spending two years instructing in Harvard Medical School's Department of Psychiatry. He is currently an associate professor teaching both undergraduate students at Laurentian and medical students.

Dr. Tai's research aims to improve our understanding of how changes occur in blood pressure regulation. Along with his research group of approximately ten Laurentian University undergraduate, graduate, and post-doctoral students, Tai often collaborates with other university faculty members to examine gene regulation and its effects on adrenaline, with respect to hypertension.

As a CIHR Leader, Dr. Tai says his role is to help develop Laurentian faculty members' knowledge of how to approach CIHR funding and applications. He notes that research grants available are few and far between, and his main goal is to try and help researchers be successful.

"I'm trying to help build research capacity, providing the opportunity for Laurentian faculty to become successful in health-related research funding."

A large part of his role, says Dr. Tai, will be demonstrating that although Laurentian is a relatively smaller institution than some of its Southern Ontario counterparts, it has an impressive track record of producing important and relevant health research.

These three new chairs will help Laurentian to continue to expand its research presence and strengthen the ties between quality research and quality teaching. **◀**

A close-up photograph of a man with short grey hair and black-rimmed glasses, wearing a blue button-down shirt. He is holding a human skull in his hands, looking directly at the camera with a neutral expression. The background is slightly blurred, showing what appears to be a laboratory or office setting.

Blunt force, forensics and fame

Dr. Scott Fairgrieve is gaining international recognition for his work in Forensic Science.

By Joanne Musico

In the spring of 2015, the Founding Chair of the Department of Forensic Science devised a challenge for the Sudbury episode of *The Amazing Race Canada*, where participants had to comb through a one-metre square 'crime scene' to find fragments of bone and teeth. Dr. Fairgrieve also has screen time in *Making a Murderer*, the popular Netflix series documenting the story of accused killer Steven Avery in Manitowoc County, Wisconsin. Dr. Fairgrieve testified for the defence in the 2007 murder trial as an expert witness in forensic anthropology. He was also lead forensic anthropologist for exhuming the remains of unidentified victims of the Titanic which resulted in the identification of Body #4 "The Unknown Child" through DNA analysis.

He's been seen in prime time, consulted with coroners, and testified in scores of criminal proceedings. But Dr. Fairgrieve says the biggest and most rewarding highlight of his career was the approval of the Forensic Science program by Laurentian's Senate in March 2004.

"Since the inception of Laurentian's Forensic Science program, we have been a leader in Canada, setting the bar for others to follow," says Dr. Fairgrieve. "We were the first university in Canada to offer Forensic Science Programs Accreditation Commission programs in 2010 and the first ever to receive FEPAC accreditation outside of the United States."

Then, in 2012, the University became the first to sign an agreement providing forensic anthropology services to the Office of the Chief Coroner of Ontario and to the Ontario Forensic Pathology Service for death investigations in Northeastern Ontario.

This casework is pivotal to funding his research at Laurentian and also pays for investments in equipment for the lab. "My funding model is a little different because rather than writing grant proposals, I have a constant source of funding that supports undergraduate students' research in my lab," says Fairgrieve, adding that 95 per cent of fourth year student thesis research done in the Forensic Science Department is published in refereed journals.

All of Dr. Fairgrieve's research now focusses on forensics: "I deal with matters pertaining to the human skeleton in respect to trauma analysis in forensic contexts, and the effects of fire, ranging from accidental house fires to cases where bodies have been burned deliberately by perpetrators to get rid of evidence."

"Since the inception of Laurentian's Forensic Science program, we have been a leader in Canada, setting the bar for others to follow."

The latest result of Forensic Science research at Laurentian? "The Traumatizer," Fairgrieve says with a smile. "I'm often called upon to testify in court and when I'm asked about how much force it takes to create specific bone fractures, I have to say I don't know." This answer makes him very uncomfortable, he says. "So, I put my head together with Dr. Brent Lievers, from Laurentian's Bharti School of Engineering, and we challenged his mechanical engineering students to come up with a solution."

The 4th-year mechanical engineering students needed a project to design and build; Dr. Fairgrieve funded the project through his lab, and together they've produced a working prototype of a bone impactor, dubbed "The Traumatizer".

"With this computer-controlled device, we can change the implements on the head of the machine using a hammer or a knife, and it will strike bone at different velocities and record the force at which the bone is struck. We can then look at the trauma on the bone and compare that to the data we get."

The Traumatizer is another 'first' for Dr. Fairgrieve, and there will be more to come. Stay tuned for the next big thing. 