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This issue marks the 10th anniversary of the launch of Headway magazine. To celebrate this milestone, we present an anniversary edition highlighting a decade of some of McGill’s most significant research developments in three far-reaching research areas: our society, our planet and our health. This issue looks at some of the disciplines where McGill researchers have been particularly busy making new connections over the past decade – and how those collaborations push new knowledge in exciting directions.

Genomics, digital activism, human rights, global food security and the mysteries of deep space – McGill has been at the forefront of research and innovation across these disciplines and others. In these pages, you will discover how now, more than ever, researchers are forging collaborative partnerships: with colleagues in other disciplines and at other universities, with non-profit organizations and philanthropists, with small- and medium-sized enterprises and with governments.

McGill’s Centre for Human Rights and Legal Pluralism (page 23), which also turns 10 this year, shows how interdisciplinary collaboration provides a new lens for viewing complicated real-world problems. The director of the McGill Institute for Global Food Security (page 28) has been working with the United Nations Food and Agricultural Organization to get a more accurate picture of undernourishment around the world. McGill researchers are consulting with the people who live in the green belt surrounding Montreal to figure out how to sustainably balance the needs of both a growing population and a precious ecosystem (page 31). The hSITE initiative (page 13) was one of the first to connect information technology researchers with the frontline health-care practitioners in need of new wireless tools. The McGill University and Génome Québec Innovation Centre (page 9) is a partnership building on the Human Genome Project, one of the biggest collaborations in the history of science.

The Headway archive is a testament to the growth and advances achieved in McGill’s research community over the last 10 years. Embracing the power of many minds and focusing on increased support for researchers makes McGill one of the leading research universities in Canada and the world.

On page 36, Vicky Kaspi, who graced the cover of Headway’s very first issue, talks about how new interdisciplinary collaborations keep research “fresh.” I couldn’t agree more – and I eagerly look forward to the breakthroughs those fresh collaborations will bring in the years to come.
THE QUEST TO FIND A CURE for Alzheimer’s disease, which affects about 750,000 Canadians, has been maddeningly difficult. Most approaches have focused on identifying genetic and environmental risk factors responsible for causing or accelerating the progression of this devastating condition.

“More than 110 new, experimental drugs have been tested in Alzheimer’s patients and they all failed miserably,” says Judes Poirier (pictured above), a professor of psychiatry and medicine. His research team recently looked at the problem differently, by asking why certain people develop the disease much later in life – or, sometimes, not at all.

After examining 800 brains over an eight-year period, Poirier discovered a protective gene variant that delays the onset of the common form of Alzheimer’s disease by almost four years. The gene in question, called HMGCR, regulates cholesterol production, and one in four Canadians carries this protective variation of the gene. Poirier showed it can also protect people diagnosed with mild cognitive impairment (MCI) by slowing progression to Alzheimer’s.

Intriguingly, among MCI patients with a high-risk Alzheimer’s gene called APOE4, those who carry the protective HMGCR gene are much less likely than non-carriers to develop the disease within three years of their MCI diagnosis. Two decades earlier, Poirier identified APOE4 – a harmful variant of a cholesterol-transport gene – as an important Alzheimer’s risk factor. “This protective cholesterol-regulating gene cancels the risk of the bad gene,” explains Poirier, associate director of the Centre for the Studies in the Prevention of Alzheimer’s Disease at the Douglas Mental Health University Institute.

Poirier’s finding provides a molecular target for developing a medication to mimic the effect of the protective gene in people who don’t carry it. Fortunately, a class of cholesterol-lowering drugs called statins, best known for fighting heart disease, work by blocking the specific enzyme made by the HMGCR gene to prevent cardiac problems. Although blockbuster statins, such as Lipitor, were never designed to enter the brain or prevent brain diseases, several studies have found that some older statins with a greater ability to cross the blood-brain barrier might reduce the risk of developing Alzheimer’s by up to 70 per cent.

Poirier has uncovered a vital new clue to help explain the larger puzzle of how the movement and synthesis of cholesterol in the aging brain can lower or raise the risk of Alzheimer’s disease. This finding creates opportunities to develop new brain-specific statins, or test existing compounds with the right properties for their possible effectiveness in preventing or delaying the disease.

The McGill researcher hopes to begin testing one of these compounds this spring in a small-scale trial to determine whether an older cholesterol-lowering medication, called probucol, can prevent or significantly delay the onset of Alzheimer’s in a group of 50 at-risk people.

“I’m not even asking for a cure,” says Poirier. “Delaying the onset of Alzheimer’s would have a much bigger impact than delaying other diseases that are not age-related. Many people would die of old age before developing the disease. If we can use a medication to delay the onset by five years, we could eradicate 50 per cent of Alzheimer’s cases within one generation.”

This research was funded by the J.-Louis Lévesque Foundation, the Canadian Institutes of Health Research and the Fonds de recherche du Québec– Santé.

– Mark Witten
THE UNNATURAL TRUTH ABOUT GLOBAL WARMING

THE ODDS ARE GREATER THAN 99 OUT OF 100 that climate change is our fault. McGill physics professor Shaun Lovejoy has crunched the numbers to prove it. He analyzed reams of historical data to assess the statistical likelihood that warming over the past century is due to natural long-term variations.

His study, published online in the journal *Climate Dynamics*, shows a less-than-one-in-100 chance - and “likely to be less than one in a 1,000” - that climate change is the result of natural fluctuation. Further, his analysis confirms the International Panel on Climate Change’s predictions that doubling the amount of carbon-dioxide in the Earth’s atmosphere will cause between 1.9 and 4.2 degrees Celsius of additional warming.

Lovejoy didn’t stop there. In a second paper, published in *Geophysical Research Letters*, he used that same statistical methodology to debunk the idea that global warming has been slowing down.

He studied data for the period 1998 to 2013, when globally averaged temperatures remained high by historical standards, but were somewhat below computer-modeled predictions. Some skeptics argue that this so-called “pause”, or “hiatus”, undercuts the theory that global warming is the result of human activity. Lovejoy’s numbers, again, beg to differ.

His study concludes that, yes, the Earth did indeed cool down by 0.28°C to 0.37°C during the “hiatus” - just like it does every 20 to 50 years. By using tree rings, ice cores and lake sediment to reconstruct pre-industrial age temperature patterns, Lovejoy found that the Earth naturally goes through such periodical fluctuations. What’s more, the cooling effect observed between 1998 and 2013 “exactly follows a slightly larger pre-pause warming event, from 1992 to 1998,” so that the natural cooling during the “pause” is no more than a return to the longer term natural variability, Lovejoy concludes: “The pause thus has a convincing statistical explanation.”

POTATO EXTRACT COULD HELP FIGHT OBESITY

LOAD UP ON POTATOES, LOSE WEIGHT. If that dietary advice sounds wrong-headed, you’re not alone. In fact, when McGill researchers found that mice gained much less weight if their fat-heavy diet included a whole lot of potato extract, they were surprised. So surprised, in fact, that they re-ran the experiment to make sure there wasn’t a mistake.

Investigators fed mice, each weighing around 25 grams, an obesity-inducing diet for 10 weeks. Mice on the control fatty diet put on a whopping 16 grams - but mice who were also eating potato extract gained only seven grams. The scientists published their findings in the journal *Molecular Nutrition & Food Research*.

The magic ingredient: polyphenols, which are naturally present in foods like potatoes, grapes and blueberries. However, it would take about 30 potatoes’ worth of polyphenol - every day - to get the obesity-curbing effects. The team hopes to patent a potato extract as a dietary supplement or cooking ingredient. They are currently seeking partners to help fund clinical trials in order to determine the beneficial effects (and optimal doses) for humans.

“I know, I know - potatoes have the advantage of being cheap to produce, and they’re already part of the basic diet in many countries,” says principal author Stan Kubow, an associate professor in the School of Dietetics and Human Nutrition. “We chose a cultivated variety that is consumed in Canada and especially rich in polyphenols.”

*This study was funded by the Natural Sciences and Engineering Research Council of Canada, the Canadian Institutes of Health Research and the Canada Foundation for Innovation.*
HOW DID EBOLA JUMP FROM ANIMALS TO PEOPLE?
The current outbreak began when a 2-year-old boy contracted the virus in the small village of Meliandou, Guinea. In April 2014, an international team of researchers, including a McGill PhD student, began searching for the animal origins of this tragic epidemic.

The Robert Koch Institute in Berlin assembled a large international interdisciplinary team consisting of virologists, veterinarians, ecologists, epidemiologists and an anthropologist.

Jan Gogarten (pictured above), a doctoral student in biology and Vanier graduate scholar at McGill, was part of the team. The researchers wanted to know whether there was a larger Ebola virus outbreak happening in wildlife in the region.

Gogarten was already in the area, doing fieldwork on primate diseases a few hundred kilometres from Meliandou. During previous Ebola outbreaks, the virus had wreaked major havoc in animal populations, at times wiping out up to 90 per cent of some great ape populations. (Hunters who then handled, or ate, those dead animals, risked contracting the disease.)

“So while I was examining the influence of primate behaviour on disease circulation,” Gogarten explains, “I also sampled dead wildlife to see if Ebola viruses were what killed them. This sometimes meant learning about a dead animal after a long day of following monkeys and then hiking out late at night to beat the scavengers and flies that can quickly dismantle a carcass.”

His findings, and those of other investigators, showed no traces of the virus in the animal population. The researchers eventually narrowed their search to a burnt-out tree in Meliandou. The tree had recently caught fire; before then, local children regularly caught, and ate, a type of bat that lived in the hollow tree. The researchers genomically sequenced soil and ash samples. They found bat DNA that pinpointed a particular species: *Mops condylurus*. “This bat species has been implicated in a previous Ebola virus outbreak, can survive experimental infections, and has even shown hints of antibodies against Ebola viruses in the wild,” says Gogarten, “so they seem the most likely source of the present epidemic.”

The Robert Koch Institute team reported their findings in the January 2015 edition of *EMBO Molecular Medicine*.

PRIME MINISTER STEPHEN HARPER visited Nahum Sonenberg’s lab at McGill’s Life Sciences Complex on May 1, 2014. The prime minister was in Montreal to announce funding for research into neurological disorders out of the Azrieli Neurodevelopmental Research Program, funded by The Azrieli Foundation, the Brain Canada Foundation and the Government of Canada through the Canada Brain Research Fund.

Sonenberg, from the Faculty of Medicine’s Department of Biochemistry and the Rosalind and Morris Goodman Cancer Research Centre, and Alan Evans, from the Montreal Neurological Institute and the Faculty of Medicine, shared more than $3.7 million from the Azrieli Program. The program focuses on autism spectrum disorders and fragile-x syndrome, and aims to develop new diagnostics, treatment and prevention strategies for these disorders.
WHAT IF DIGITIZED MUSICAL SCORES COULD BE SEARCHED for a particular sequence of notes, rhythms, or intervals? Music scholarship would be forever transformed. That is the goal of the Single Interface for Music Score Searching and Analysis project (SIMSSA), led by Ichiro Fujinaga of the Schulich School of Music. The objective of SIMSSA is to build the tools to teach computers to recognize the musical symbols in images and assemble the data on a single website, making it possible to search and analyze online musical scores for the first time. "We have never been able to search through a large amount of music using an optical music recognition computer program," Fujinaga says. “People have dreamed about it for decades, but it is more complicated than creating a program for searching through text. [Creating this program] will revolutionize music research.”

Fujinaga is one of five McGill researchers recently awarded six- or seven-year investments from the Social Sciences and Humanities Research Council (SSHRC) partnership grants program.

Andrew Piper, of the Department of Languages, Literature and Cultures, is leading a multi-disciplinary and multi-institutional team of experts to help develop a more comprehensive study of the novel’s place within society, in particular since the 18th century. Collaborators include literary historians, text mining experts and representatives from collections of digitized literary material and digital publishers.

The partnership led by Peter Brown, from the Department of Geography and the School of Environment, is looking at the Anthropocene, how many scientists refer to the human-dominated period since the Industrial Revolution. Grounded in ecological economics, the project is aimed at investigating human-Earth relationships, with a focus on water security, energy resources and climate justice. It brings together collaborators from academia, government and NGOs.

The two other McGill-led projects are benefiting from the International Partnerships for Sustainable Societies program, a joint initiative between SSHRC and the International Development Research Centre.

Claudia Mitchell, from the Department of Integrated Studies in Education, will examine the relational and institutional settings in which sexual violence occurs in South Africa and in Canada. She will partner with colleagues at the University of KwaZulu-Natal, South Africa, and community-based organizations. The research will be informed by girls and young women themselves through digital storytelling, drawing and mapping, community radio and social media.

John Galaty, from the Department of Anthropology, will work with the African Conservation Centre in Kenya, along with other collaborators, to help design conservation programs in East African communities that protect biodiversity while improving access to natural resources and strengthening livelihoods in the region. The research will address the role of local communities as partners in protected-area conservation and study the effect of conservancy experiments on local livelihoods, attitudes, and natural resource practices.

The five projects will receive a total of approximately $12 million.

Above: The Maasai people of the Ngorongoro Crater, Tanzania, had to resettle outside the rim of the crater after being expelled in 1976 by the Conservation Authority.
NEW GIFT USES BRAIN IMAGING TO IMPROVE CHILDHOOD MENTAL HEALTH

WHY ARE SOME CHILDREN VULNERABLE to conditions like attention deficit disorder and social anxiety? What can be done to prevent these disorders before they take hold? These are some of the driving questions behind the Ludmer Centre for Neuroinformatics and Mental Health. A new $2.9-million gift from the Irving Ludmer Family Foundation will support state-of-the-art brain imaging and brain mapping techniques, based in the McConnell Brain Imaging Centre at The Neuro, in the hope that this work will lead to answers.

Established in 2013, the Ludmer Centre for Neuroinformatics and Mental Health is a partnership between the Douglas Mental Health University Institute, the Jewish General Hospital, The Neuro (the Montreal Neurological Institute) and McGill University. The centre focuses on the study of young brains, since many of the most prevalent forms of mental illness take root during childhood. (Ludmer Centre researchers are also exploring brain disorders in the aging population, such as dementia, in an unprecedented investigation of mental health across the lifespan.)

Three McGill professors serve as the centre’s principal investigators: Michael Meaney is the James McGill Professor of Psychiatry, Neurology and Neurosurgery at the Douglas Mental Health University Institute; Alan Evans is the James McGill Professor of Neurology and Neurosurgery, Psychiatry and Bioengineering at The Neuro; and Celia Greenwood is a senior investigator at the Lady Davis Research Institute of the Jewish General Hospital, and an associate professor in the departments of Oncology, Epidemiology, Biostatistics and Occupational Health, and Human Genetics at McGill.

These scientists, and their teams, are working to understand how different genetic and environmental factors influence brain development in children. Evans’s high-resolution 3-D brain imaging laboratory will provide an unprecedented picture of how mental health and illness are manifested within the brain across the lifespan. This information will drive Meaney’s groundbreaking epigenetic research, which explores how changes in the environment – even before birth – can affect how children’s brains develop. Greenwood’s expertise in biostatistics will allow for a thorough analysis of the large quantities of genetic and genomic data needed to identify risk factors in individuals and across populations. These discoveries may open new pathways for diagnosis, prevention and treatment, and have a far-reaching impact on millions of children debilitated by mental illness, and the families and communities who help care for them.

“If nobody starts doing this work now, where will we be in 25 years?” asks Irving Ludmer (pictured left), a 1957 graduate of McGill’s Faculty of Engineering and the current president of Cleman Ludmer Steinberg Inc., an investment holding company. “This is a big data project – we’re going to need lots of cohorts to get the kinds of information that will allow us to find meaningful correlations.”

“This collaborative partnership promises to transform the discipline in much the same way Wilder Penfield did,” says Guy Rouleau, the director of The Neuro, “putting Montreal and Quebec at the forefront of a genuine revolution in mental health and human development.”
AFTER THE TURMOIL OF THE 2008 CRASH, it seemed there was no space for another smear on the reputation of the financial markets. Yet research by Patrick Augustin (pictured above) suggests a surprisingly large number of mergers and acquisitions spur “abnormal” activity on the options market consistent with insider trading.

Augustin, an assistant professor of finance in the Desautels Faculty of Management, collaborated with colleagues at New York University to analyze mergers and acquisitions dating from 1996 to 2012. M&As are supposed to be surprise announcements with predictable effects on stock price.

“We know, in every single case, that stock price will rise. So now we can do this other experiment – what would someone with inside information do, as a directional trading strategy?” asks Augustin.

The answer lay in the options market. Options are contracts to buy or sell specific stocks at specific prices within a certain time frame. They offer a more nuanced source of data than normal stock trades.

“With this very rich information, we can ask what would we expect to happen if there’s a significant amount of directional trading going on that’s consistent with someone betting on the stock going up in advance of certain information becoming public.”

DO MERGERS AND ACQUISITIONS SPUR INSIDER TRADING? //

The good news, says lead author and McGill psychology professor Jeffrey Mogil, is that “the problem is easily solved by simple changes to experimental procedures. For example, since the effect of males’ presence diminishes over time, the male experimenter can stay in the room with the animals before starting testing. At the very least, published papers should state the gender of the experimenter who performed the behavioural testing.”

This research was supported by grants from the Louise and Alan Edwards Foundation, the Natural Sciences and Engineering Research Council of Canada and the U.S. National Science Foundation.
TWO MCGILL-LED RESEARCH TEAMS WERE AMONG THE RECIPIENTS of the latest round of funding from the Collaborative Research and Training Experience (CREATE) program announced by Ed Holder, minister of state for Science and Technology, at an event held at McGill last May.

CREATE is a Natural Sciences and Engineering Research Council of Canada (NSERC) program designed to help graduate and postgraduate students move into the workforce by giving them the opportunity to enhance their professional, communication and collaboration skills, as well as providing experience relevant to both academic research and non-academic environments.

One of the grants was awarded to Murray Humphries of the Department of Natural Resource Sciences, who studies the sustainable development of the North. With program nodes at McGill and the University of Alberta, the grant will allow graduate students in environmental sciences to do internships with industry, government agencies and aboriginal organizations.

The other McGill team is led by Stephen Yue, director of the McGill Institute for Aerospace Engineering. In collaboration with the non-profit Consortium for Research and Innovation in Aerospace in Québec, the program will enable students to develop a range of personal and professional skills and a better understanding of aerospace design and production processes, through a series of workshops and seminars, many of which will be offered by the aerospace industry. Each team received $1.65 million.

Minister Ed Holder (front) took a tour of the Advanced Composite Materials lab of Pascal Hubert (back) when he visited McGill. Hubert is a member of the McGill Institute for Aerospace Engineering. Also in the photo: Janet Walden, CEO, NSERC (left); and Dr. Rosie Goldstein, vice-principal (research and international relations), McGill.
A staff scientist at MIT in Boston, Ken Dewar worked in one of the many labs that collaborated on identifying the 3 billion molecules that, strung together in a double-helix, make up our DNA. Now an associate professor jointly appointed to McGill's Department of Human Genetics and Division of Experimental Medicine, he still has a T-shirt from the big party in 1999 celebrating the sequencing of the genome's first billion base pairs—less than a third of the way to the finish line. “It was a huge achievement,” he recalls. “But fast-forward to today, and it’s so completely trivial compared to what we can do now. It’s a totally different world.”

It took hundreds of scientists in dozens of labs more than a decade, and a billion dollars, to create that first “map” of all the cytosine, guanine, adenine and thymine nucleotide bases (abbreviated as simply, C, G, A or T) that chain together to create a single DNA molecule. Thanks to recent improvements in instrumentation speeds, that same result can now be achieved for a couple of thousand dollars in less than a week. In fact, today’s sequencing systems are so superior to that used in the Human Genome Project that it has become more efficient to sequence more than one genome at a time.

“In the last five years, the rate of production of genomic data has completely changed,” says Dr. Tomi Pastinen, who holds the Canada Research Chair in Human Genomics. Like Dewar, Pastinen works out of the McGill University and Génome Québec Innovation Centre. He remembers when a graduate student’s skill was measured in how deftly they handled a pipette; he estimates that 98 per cent of his research today takes place in front of a computer. In his own
research, which focuses on diseases such as childhood leukemia, the recent technological advances have moved him away from hypothesis-driven experiments that focus on one or two genes at a time.

“It’s easier actually to study the whole genome at once, and then analyse data and extract what you need,” he says. “It’s more cost-effective to globally test everything, and it’s less biased toward what an individual investigator thinks might be important. In two weeks, you can generate enough data to keep you busy for two years.”

“But computer science has made amazing progress, too,” Dewar adds, “so we can do these analyses much faster than ever before.”

DELIVERING ON THE PROMISE?

“Now the big question,” says his fellow centre researcher, Jacek Majewski, “is what do we do with all that data?” Majewski is an associate professor in the Department of Human Genetics and holds the Canada Research Chair in Statistical Genetics. He started his doctoral studies during the early days of the Human Genome Project, when DNA sequencing required toxic gels and jotting down long lists of nucleotides by hand. It was a labour-intensive process, but hopes were high for an eventual big payoff.

The early dream was to have a map of our DNA that was going to open the door to high-impact translation research that would cure genetic-based ailments affecting billions of people: heart attacks, diabetes, asthma. When asked how likely it is that we’ll see these cures in the next 10 years, Majewski doesn’t mince words. “Probably not,” he says. “The complexity of those diseases was underestimated and the research will not produce translational results for a longer time than expected.”

The hope was that those big diseases were each predominantly caused by a single, or at most a few defective genes. They’re not. Although there are rare forms of, say, diabetes that have been traced to a lone defect – and knowing the gene responsible can make it much easier to choose the appropriate therapy – the more common occurrences of these maladies are caused by the interactions of dozens of genes, not just a single misfire. “The person who is susceptible to diabetes probably has subtle variations in 10 to 20 genes, or even up to 200, that interact to cause the problem,” explains Majewski. “This makes it much harder to understand and target. The sheer complexity of the problem is not something that we foresaw when we started these projects.”

Dr. Rob Sladek, an endocrinologist and an associate professor of human genetics and medicine, echoes Majewski’s sentiments.

“It’s true that complex and late onset diseases are far more complicated than we anticipated...but hope is far from lost. New methods and better-designed studies are making tremendous inroads.

“We’re moving into completely different realms of genomics, where our collaborations with groups in other fields, notably physics and computer science, are giving us the opportunity to monitor the dynamics of genome rearrangements and gene expression on single cells using nanotech devices.”

The legacy of the Human Genome Project is already paying dividends in basic research – and we’re already seeing that new knowledge is driving advances in clinical care. The effect, says Majewski, is most profound in two areas: testing for rare, recessive diseases and developing precision treatments for cancers.

As many as one in 20 people suffer from a rare disease that stems from congenital or metabolic defects. There are thousands such diseases, each having debilitating effects on the lives of a few hundred people. “These are things we can now prevent through genetic testing, and that’s thanks to the human genome. To me, that’s very exciting,” says Majewski. “For years, I was a basic researcher. I loved it, but it was very abstract. Now having something that’s able to help somebody is a gratifying part of the research.”

Genomics is also proving the key to getting cancer patients started on the correct drugs much earlier in their treatments than ever before. By sequencing a biopsy, and comparing a cancerous tumour’s molecular profile against a database showing how
certain mutations have responded to particular drug therapies, a physician can now more quickly prescribe the best treatment. One of the cancers that Majewski studies is glioblastoma, an aggressive brain tumour that might be caused by a chromosomal rearrangement. Basic genomic research has revealed that this rearrangement fuses two gene products (FGFR and TACC); a new drug treatment that inhibits FGFR function is now showing promise in treating glioblastoma patients.

WHAT’S NEXT?

Although precision therapy already has profound implications for improving patient outcomes after disease has struck, Dewar isn’t sure genomics will ever yield the Holy Grail: tweaking our genes to prevent disease from ever starting. “There are tremendous hurdles,” says Dewar, whose two main research streams focus on monkeys and microbes. “Count the number of cells in your body that have a nucleus. Every nucleus has a copy of your genome—and you have to find a way to correct them all? It’s unclear how realistic that will ever be. Instead, we need to find out how to counteract the defect by other means.”

But if modifying every copy of a person’s genome isn’t feasible, modifying the microbiome, the collective genome of all the microorganisms living inside that individual, is one of the possible avenues. Dewar led the team that sequenced the strain of C. difficile that killed hundreds of people in Quebec during a 2003 outbreak; sequencing those bacteria has allowed better testing to identify patients infected with the most virulent strains. He points to the 95-per-cent success rate of fecal-transplant therapy in curing C. difficile, where traditional antibiotics have failed. (Fecal-transplant therapy is exactly what it sounds like: curing a sick person by recalibrating their micro-ecology through controlled exposure to the feces of a healthy, non-infected donor.) Dewar suspects that this kind of literal micromanaging of the genetics of the microbiome might prove the path to eliminating, or controlling, many illnesses in the near future. Possible candidates for this treatment include disorders related to nutrient uptake and metabolism, as well as bowel inflammation syndromes.

“Those studies of microbial ecologies and populations could not have been considered 10 years ago because of the complexity of the number of species and the cumulative size of the genome of all the things in there,” he says. “But now, we can sequence them—the problem is figuring out what exactly we’ve sequenced when 90 per cent of them are completely new to science.”

“Things have moved so fast,” says Pastinen. “The more we do genome science, the more granularity we find in the way human genomes and human cells work. Even though I worked on genomic techniques during the later stages of my MD/PhD, and knew what was coming, I couldn’t have envisioned what happened in the past 10 years.”

Confident that cancer genomics has revealed “almost all the genetic culprits” that disrupt the epigenome (the genome’s chemical functions), Majewski’s and Pastinen’s teams are now collaborating with basic researchers at Rockefeller University to design new molecules to repair the problem.

“I love the fact that the two research approaches are coming together,” Pastinen says. “The basic researchers have been studying these epigenetic processes for many years. And human mutations link them to direct phenotypic consequence: They cause cancer. Now, on the applied side, we can study it backwards to understand how these mutations disrupt the basic process, then design new drugs to counter those defects.

“My basic training is in medicine,” he adds. “My interest is still in improving the human condition, not just in finding out how the genes turn on and off. If you just want to understand biology, you can do it in yeast.”

The research described in this article is funded by the Bachynski Family Foundation, the Canada Foundation for Innovation, the Canadian Cancer Society Research Institute, the Canadian Institutes of Health Research, the Cancer Research Society, the Crohn’s and Colitis Foundation Canada, the Fonds de recherche du Québec – Santé, Genome Canada, Génome Québec, the National Institute of Diabetes and Digestive and Kidney Diseases, the National Institutes of Health and Tekes (Finland).
Physicians at the Cedars Breast Clinic of the McGill University Health Centre (MUHC) had an unusual order: they wanted to be able to detect the small lumps that might be signs of breast cancer without resorting to uncomfortable, and radioactive, mammograms. A team led by McGill professors Milica Popovich and Mark Coates, from the Department of Electrical and Computer Engineering (ECE), in collaboration with Université Laval professor Leslie Rusch and the MUHC clinicians, delivered the “tomo-bra,” prototypes of which are currently being tested on volunteers.

Worn like a bra, the device uses an array of microwave antennae to send and receive low-energy signals that produce a scan—a tomograph—of the breast tissue, enabling clinicians to spot changes in tissue density that could indicate a tumour. “The mammogram is uncomfortable, to say the least; it hurts. But the tomo-bra involves no discomfort or pain,” says Popovich, who has experienced both. While the tomo-bra would not replace mammography, it does create more diagnosis options. As Coates says, “Because there is no need to worry about ionizing radiation, women who have a high risk for breast cancer could use the tomo-bra monthly as an early-warning system telling them if they should follow up with a mammogram.” Frequent exposure to ionizing radiation can lead to cancer.

The tomo-bra evolved within the Healthcare Support through Information Technology Enhancements Strategic Research Network. Based at McGill, hSITE has been funded since

In health care, information is crucial: The data shared by doctors and nurses determine a patient’s diagnosis and care. McGill researchers with the hSITE Strategic Research Network are using new technologies to improve the speed, accuracy and efficiency of medical services. //

By Patrick McDonagh
October 2008 by a $4.8 million grant from the Natural Sciences and Engineering Research Council of Canada (NSERC), along with almost $3 million of cash and in-kind support from partners in industry and health care. The network was set up to help develop the information and communications technology (ICT) components needed to enhance efficiency in health care clinical environments. To do this, hSITE researchers consulted with clinicians to understand their needs and develop the tools to address them. “The best way to make our research useful is to work with people who have problems that need solving,” says David Plant, hSITE’s scientific director. “When we launched hSITE, it was avant-garde to connect health-care practitioners to ICT researchers developing wireless applications.” Today, many products of hSITE research are being used in partner hospitals, with some being prepared for further commercialization.

In addition to Plant, Coates and Popovich, McGill is represented in the network by ECE professors Tho Le-Ngoc and Fabrice Labeau. The network includes another 18 researchers in eight other Canadian universities, along with partners in industry – including IBM, Telus Health, which develops information technologies for health care applications, and ParaMed Home Health Care, an industry leader in home and workplace health-care services – as well as health-care providers, including the MUHC, Toronto’s University Health Network and Mount Sinai Hospital, Calgary’s Ward of the 21st Century, and Ottawa’s Elisabeth Bruyère Hospital.

One of the technologies far beyond the prototype demo phase is a patient-tracking system developed by Tho Le-Ngoc and his team. The research team consulted closely with medical staff at the Royal Victoria Hospital (RVH)’s Division of Geriatrics Medicine to build a tracking system for patients who may wander from the acute care ward. The patients carry a small tracking device that can be worn as a watch, pinned on as a badge, or simply placed in a pocket. Consequently, staff can locate them if they roam – and the device can also trigger locks on certain doors as patients approach them. The same technology can track wheelchairs and other equipment, enabling staff to retrieve equipment when needed. It has also been used in the RVH Emergency Room to examine workflows, helping clinicians to devise the most efficient layout of ER equipment to speed up the delivery of health care.

Le-Ngoc’s team has also worked with RVH Emergency Room physicians to create a wireless connection for the vital signs monitor. “Right now the nurse reads the monitor’s output and records it on paper before uploading it into the system,” Le-Ngoc explains. “So two problems can occur: first, the data may not be correctly transcribed, and second, hours may pass between recording the information and putting it into the system.” The team has upgraded the monitors by designing attachable hardware that enables nurses to connect to the monitor via their smartphones and then upload the patient’s vital information directly to the network. “Not only is this fast and efficient,” says Le-Ngoc, “but it could be very useful when monitors are used at a distant emergency site. For example, if paramedics need to send patient information – such as blood pressure, pulse, blood oxygen levels and so forth – from a car accident site to a hospital, so the staff there can prepare to receive the patient.”

All these bits and bytes travelling over wireless networks pose a new challenge: How to manage these data? “Acquiring all the signals from all the patients in a hospital and transmitting them to a central server imposes an immense load on the hospital’s wireless network,” says Fabrice Labeau. “But not all this information is relevant or time-critical.” The system must somehow understand the particular relevance of each one and prioritize it appropriately: Emergency signals must take priority over routine monitoring signals. “For instance, electroencephalography (EEG) monitoring creates a lot of data,” says Labeau. “There could be anywhere from a few to a few dozen electrodes attached to a
patient's skull, all emitting signals." If a patient experiences a seizure, the signal changes and clinical staff are alerted. One of Labeau's PhD students, Hoda Daou, developed a programming technique that allows for the simultaneous compression of the EEG signals and monitoring of their regularity, thereby allowing emergency signals to still take priority.

Much of the research performed under the hSITE banner has tremendous commercial potential, making it attractive to the network's industry partners. IBM donated its costly WebSphere software to Le-Ngoc's team to use as a reference for the development of the patient tracking system. According to Don Aldridge, a research executive at IBM, Le-Ngoc's project provided the company with "a real-world test environment for our then-nascent tracking technologies...This project now serves as a key reference for IBM as we deploy similar solutions in hospital settings globally." Other industry partners proposed avenues for research. Telus Health, for instance, worked closely with University of Toronto researcher Joe Cafazzo to investigate communications issues related to the transfer of patients between clinicians, and the technologies developed from this research may lead to commercial health care apps.

While the hSITE network will close shop at the end of 2015, the connections it has made will endure, and research will continue. The RVH Geriatrics team is considering implementing Le-Ngoc's tracking system after it moves to its new facilities in 2015, and Coates and Popovich plan to continue testing and refining the tomo-bra at the MUHC until a prototype is ready for commercialization. In addition, Le-Ngoc and Labeau have developed international collaborations in China, building on their hSITE work to find ways to help Chinese researchers devise techniques for managing huge data loads from home-care monitoring—a growing issue in that country.

"One of hSITE’s most riveting outcomes is that we’ve gained the trust of health-care practitioners and can work closely with them," concludes Plant. "It isn’t easy to take engineering innovations past the lab’s testing and measurement equipment and into real health-care centres with real patients." Much of the challenge lies in forging the first links. "I know from experience that trying to establish a collaborative relationship cold, by yourself, is uphill work," says Coates. "Just finding the right person to talk with, the person who might be interested in doing something with you, is difficult. But being part of this network is a tremendous asset. hSITE has brought together people from different communities and established a lot of communication." ■

Other hSITE partners include Alberta Health Services, BlackBerry, QNX, Avaya, Carleton University, the University of Alberta, the University of Calgary, the University of Ottawa, the University of Victoria, the University of Waterloo and the Ottawa Hospital.

01 The tomo-bra produces a scan of the breast tissue, enabling clinicians to spot changes in tissue density that could indicate a tumour.
02 Tho Le-Ngoc’s team developed a small tracking device that helps medical staff locate patients or equipment.
03 The team also designed hardware that enables nurses to connect to vital signs monitors via their smartphones and then upload a patient’s information directly to the network.
04 A programming technique developed by PhD student Hoda Daou allows for the simultaneous compression of EEG signals and monitoring of their regularity.
Imagine pressing your hand on a stove burner and turning it on. How long would it take you to feel pain? Depends on your genes, says Dr. Luda Diatchenko (pictured right), a professor in the Faculty of Medicine’s Department of Anesthesia and in the Faculty of Dentistry. “Half of our pain sensitivity is determined by our genetic makeup,” explains the scientist, who joined McGill and its Alan Edwards Centre for Research on Pain in 2013 as Canada Excellence Research Chair (CERC) in human pain genetics.

A decade ago, Diatchenko performed similar pain-sensitivity tests on 202 healthy female volunteers at the University of North Carolina (UNC). In this pivotal experiment, researchers pressed a small metal cylinder against the skin of the volunteers, heating it mildly to determine the tolerance level of the subject and then delivering pulses of heat at a slightly lower temperature. The results led Diatchenko to uncover a key genetic clue to help solve the perplexing puzzle of why some people are able to withstand high levels of discomfort while comparable pain causes others to suffer intensely. She discovered that the women who felt the heat more quickly and experienced more pain with each additional pulse of heat carried a variant of a gene called COMT, which produces an enzyme that controls the level of stress hormones by metabolizing them.

This high-pain sensitivity (HPS) variant amplifies pain because it produces less of the COMT enzyme, leading to an excess of non-metabolized stress hormones. Carriers of the HPS variant are also more likely to develop chronic pain conditions, such as fibromyalgia (characterized by widespread musculoskeletal aches and stiffness) and temporomandibular joint disorder (a facial muscle pain condition), which affect about 10 per cent of Canadians. “This finding was exciting because it was the first time a researcher showed an association between a common genetic marker and substantially different experiences of pain,” says Diatchenko.

Building on these findings, Diatchenko’s goal today is to map out other genetic mechanisms at the roots of chronic pain to help develop much more effective personalized pain therapy strategies for common conditions like lower back pain, tension headaches and arthritis. “Pain is the number one reason why people see doctors, and the economic costs to society are greater than the costs of cancer, diabetes and heart disease combined,” she says. “Clinicians want to know what medication will be best for each patient and we want to give them the tools to tailor treatment to the patient’s genetic profile.”

One avenue Diatchenko is exploring is the treatment of pain using drugs that block beta receptors (proteins that bind to stress hormones, thereby weakening their effects), a class of drugs...
commonly used to manage heart disease. In a 2010 study, Diatchenko showed that chronic pain patients carrying the HPS variant of the COMT gene got more pain relief from the beta blocker propranolol than those with other variants of the gene. Now, she plans to test the effectiveness of another beta blocker for the carriers of the HPS variant. “This beta blocker targets the pain receptors better, so it reduces pain more efficiently and has fewer side effects. [Propranolol’s side effects include drowsiness and depression.] At a later stage, if we find it’s not effective enough, we could also modify the drug specifically for the treatment of pain,” she says.

Diatchenko, who holds a medical degree and a PhD in molecular biology from the Russian State Medical University, started her career in the biotech industry in California, developing new and still widely used tools for analyzing gene expression and regulation. In 2000, she joined a pain research group at the University of North Carolina. “I found the field of chronic pain research so fascinating and so neglected from a medical research point of view, given the complexity of the problem. I thought it showed a lot of promise in terms of what could and needed to be done,” says Diatchenko.

In 2005, she also co-founded Algynomics, a pain genomics company that is helping to move some of her promising discoveries toward clinical applications faster. For example, the results of her UNC pain-sensitivity study led to the development of a test for the HPS variant of the COMT gene that is used by biotechnology companies that use genetic markers. “Coming from an industry background, I saw Algynomics as providing me with the opportunity to oversee the transformation process from discovery to application. Also, by collaborating with pharmaceutical companies, it gives our research group access to large additional cohorts of chronic-pain patients,” says Diatchenko, who continues to be involved with Algynomics.

The CERC program, established by the Canadian government in 2008, provides Diatchenko’s research team at McGill with $10 million in federal funding over seven years and more than $20 million in matching funds from private and public partners. This funding will allow the University to recruit five new professors to support Diatchenko’s research. “Personalized medicine to treat chronic pain is a new, cutting-edge area that we wanted to develop,” says Fernando Cervero, director of the Alan Edwards Centre for Research on Pain. “We have excellent people doing brain imaging, preclinical studies in pain genetics and epigenetics, and a very strong clinical research group. Luda’s expertise will help build on our worldwide reputation as a pain research centre so that McGill can be a leader in developing personalized pain medicine over the next 15 years.”

Luda Diatchenko holds the Canada Excellence Research Chair in Human Pain Genetics. The $10-million CERC funding from the government of Canada is matched by more than $20 million from private and public sources, including the government of Quebec, the Canada Foundation for Innovation, Pfizer Canada and McGill University. The Alan Edwards Centre for Research on Pain is supported by the Louise and Alan Edwards Foundation.
When Shaheen Shariff asked a group of under-18-year-olds whether a teenage girl has the right to object to her boyfriend sharing a nude photo of her with his friends without her consent, she was shocked by the responses. “Forty-six per cent of the students said the girl deserved to be harassed and demeaned because she behaved like a ‘slut,’” says Shariff, a professor of integrated studies in education at McGill. The students believed that her right to privacy was destroyed when she sent it to her boyfriend in the first place, even though she had intended it to be seen only by him. This is consistent with a large body of literature on “slut-shaming” that Shariff references in her new book Sexting and Cyberbullying: Defining the Lines for Digitally Empowered Kids.

"As long as girls express their sexuality within the accepted norms of their peers, without standing out too much, they are accepted," Shariff says. “However, when they are seen as crossing the line to assert their sexuality in ways that may create jealousy and envy, they are labeled ‘sluts’ who deserve to be humiliated publicly and put back in their place. And it’s interesting to try to figure out, what is that line?”

Determining that boundary is at the heart of Shariff’s current research program, Define the Line, which aims to clarify the lines between cyberbullying and digital citizenship, to help inform policymaking, education and law, as well as to better understand adult and youth conceptions of public and private space. The study was partially funded by Facebook’s inaugural Digital Citizenship Grants, as well as by the Social Sciences and Humanities Research Council of Canada.

Cyberbullying can range from postings of non-consensual intimate images to gossip, slut shaming and even defamation. “Once bullying moves into cyberspace, it can be saved, retrieved and distributed until it spreads virally,” explains Shariff, who is considered a pioneer academic on the topic. “You can’t walk away from being harassed online.”

Though an increasing amount of social interaction is taking place in cyberspace, the lines dictating appropriate online behaviour remain unclear. McGill researchers are examining the effects the Internet is having on groups as diverse as teens, workers and political activists. //

By Laura Pellerine
To collect data, Shariff and her team sent out anonymous online surveys to 1,088 children in schools in Montreal, Vancouver, Seattle and Palo Alto, Calif., and also conducted focus groups – one with kids aged 8-12; another with teens aged 13-18. Their work provided, for the first time, clear evidence that cyberbullies have difficulty distinguishing between harmless joking and harmful behaviour.

Young people also appear to have difficulty distinguishing between public and private conversations. “They impulsively share intimate images and confidential information on social media and tell us the information was only meant for friends, but forget that it is a very public sphere. Some kids vent on Twitter without realizing the implications, or use Twitter or Facebook almost as a personal diary.”

The guidelines on critical media and legal literacy Shariff develops will be used to help parents, teachers, policymakers and the legal community better understand the influences and context surrounding young peoples’ behaviour online, so they can foster responsible use of social media. As part of its program, the Define the Line team is developing interactive tools and teaching materials that will be accessible on its website.

Next, Shariff plans to tackle issues highlighted by recent allegations of sexual assault against former CBC host Jian Ghomeshi and American comedian Bill Cosby, as well as by a number of incidents of sexist behaviour and harassment on university campuses in Canada and the United States. She will examine ways in which sexual violence, adult modeling of sexism and misogyny, and systemic tacit condoning of these behaviours prevent women and girls from reporting these forms of abuse.

REPUTATION FIRST

Parents and their teens are not the only ones having to engage in a dialogue about the consequences of social media postings. So are organizations and their employees.

Emmanuelle Vaast, a professor of information systems at McGill’s Desautels Faculty of Management, recently conducted research on how companies are reacting to their employees’ use of the workplace’s social media platforms like Facebook and Twitter. She examined social media policies from 74 organizations in a variety of industries and sectors from as early as 2005 to as late as 2012.

“Considering that much of social media use is bottom-up and employee-driven in nature, management faces a number of challenges, as it stands to lose some of its traditional control over some of the information technology initiatives being implemented and followed in the organization,” Vaast says.

In her research, Vaast and her co-author Evgeny Kaganer, from the IESE Business School in Spain, discovered that, initially, company guidelines focused more on damage prevention. “Guidelines about what not to post were more frequent and specific than about what to post, and more concerned about mitigating potential risks associated with visibility and the durable traces left by online activities.”

Coca-Cola has reminded its employees that, “the Internet is permanent. Once info is published online, it is part of a permanent record, even if you remove/delete it later,” while the Australian government noted that, “once online material is in the public domain, there is little control or influence over how it might be used or modified.”

However, as social media became more common and well used in the workplace, Vaast and her co-author found that, over time, policies also evolved. “Our results showed how organizations’ reactions to social media evolved from being solely concerned with risk management to also considering its value-generating potential,” Vaast says.

In earlier policies, employees were expected to report to direct supervisors or managers in matters concerning the company’s social media platforms, while in later documents, the role of a social-media manager began to emerge as an authority to oversee and advise employees.

Vaast notes the potential for further investigation in this area, such as examining corporate policies from non-English-speaking countries to better understand cultural and societal distinctions in social media governance in the workplace.
POLITICAL WEAPON

Organizations can design ways to try to minimize threats—to their reputation or their operations—coming from within, but the anonymity provided by the cyberworld is an optimal breeding ground for external threats. Hacktivism, for example—the use of computers or online networks for political ends—has grown significantly in the past decade and Gabriella Coleman, from McGill’s Department of Art History and Communications, predicts that “we are only at the dawn of this movement.”

The anthropologist, who holds the Wolfe Chair in Scientific and Technological Literacy, is the world’s leading expert on Anonymous. Originating in 2003, the once loosely organized, web-based collective that began as online pranksters, has since evolved into “hacktivists,” targeting global issues ranging from anti-digital piracy measures (aimed at preventing illegal downloading) to supporting the pro-democracy protesters in Hong Kong—all from the comforts of their homes and keyboards.

Coleman started to study the group “by accident,” curious about their early protests against the Church of Scientology. “They first pranked the organization, then protested against them, and I was intrigued by this transformation from Internet hell-raisers to activism.”

At the time, in 2008, Anonymous was viewed as politically insignificant, but once they became involved with Wikileaks, they suddenly garnered more attention. “As they became bigger and got into more illegal activities as a form of protest, it became difficult to study them, and I was pretty much the only academic doing it,” Coleman says. “I spent time wherever they spent time, which was online, mostly in chat rooms and chat channels,
and communicated with them in private and public channels. I wasn’t in channels where they were planning illegal activities, though; I got some of that information afterward, after people were prosecuted.”

Coleman offers the public a chance to delve deeper into the mysterious subculture of the group in her recent book, *Hacker, Hoaxer, Whistleblower, Spy: The Many Faces of Anonymous*. “Basic sociological data on the group is really hard to come by,” she says, “but that’s what makes them so interesting.”

One discovery her research unearthed is that while a third of the group had a history of activism prior to joining Anonymous, the rest of its members became drawn to crusading as a result of the group’s actions.

“The majority are between 15 and 25 years old, so there’s a coming-of-age element to this,” Coleman says. “The hacker population around the world is enormous, and a slice of that population became politicized through Anonymous. There is a lot of whistleblowing going on right now, and even though there are big risks and big consequences, it’s not going to go away.”

In the coming year, Coleman will turn her attention to a different aspect of hacking: disability.

“The Internet has given a lot of people with disabilities—particularly people who are homebound—access to a social community that maybe they didn’t have before, or a different place where they are able to work and engage.”

Coleman points out that the history of hacking has many connections to disability. In fact, its underground roots go back to a group of kids who were illegally hacking into the phone system by whistling matching tones in perfect pitch. A number of these “phone phreaks” had a big thing in common: they were blind.

“They were kids stuck at home, they didn’t have a lot of friends, and yet they found freedom through exploring phone systems,” Coleman says. “This is just one example of how digital technology can create social spaces for people with disabilities.”

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**HANDLE WITH CARE**

Thousands of research papers each year are now based on data gleaned from social media. But mounting evidence of flaws in many of these studies points to a need for researchers to be wary of serious pitfalls that arise when working with huge social media data sets, according to a recent study by researchers at McGill and Carnegie Mellon University.

“Many of these papers are used to inform and justify decisions and investments among the public and in industry and government,” says Derek Ruths, an assistant professor in McGill’s School of Computer Science. In an article published in the Nov. 28, 2014 issue of the journal Science, Ruths and Jürgen Pfeffer of Carnegie Mellon’s Institute for Software Research highlight several issues involved in using social media data sets.

Among the challenges:
- Different social media platforms attract different users, yet researchers rarely correct for the distorted picture these populations can produce.
- Publicly available data feeds used in social media research don’t always provide an accurate representation of the platform’s overall data.
- The design of social media platforms can dictate how users behave and, therefore, what behaviour can be measured. For instance, on Facebook the absence of a “dislike” button makes negative responses to content harder to detect than positive “likes.”
- Large numbers of spammers, which masquerade as normal users on social media, are mistakenly incorporated into many measurements and predictions of human behaviour.
- Researchers often report results for groups of easy-to-classify users, topics, and events, making new methods seem more accurate than they actually are. For instance, efforts to infer the political orientation of Twitter users achieve barely 65-per-cent accuracy for typical users—even though studies (focusing on politically active users) have claimed 90-per-cent accuracy.

Many of these problems have well-known solutions from other fields, such as epidemiology, statistics, and machine learning, Ruths and Pfeffer write.

“Social scientists have honed their techniques and standards to deal with this sort of challenge before. The infamous ‘Dewey Defeats Truman’ headline, from the 1948 U.S. presidential election, stemmed from telephone surveys that under-sampled Truman supporters in the general population,” Ruths notes. “Rather than permanently discrediting the practice of polling, that glaring error led to today’s more sophisticated techniques, higher standards, and more accurate polls. Now, we’re poised at a similar technological inflection point. By tackling the issues we face, we’ll be able to realize the tremendous potential for good promised by social media-based research.”

— Chris Chipello
In the decade since it was founded, the Centre for Human Rights and Legal Pluralism at McGill’s Faculty of Law has probed the challenge and meaning of securing human rights in a legally diverse world. //

By Victoria Leenders-Cheng

Later this year, the Truth and Reconciliation Commission of Canada will present a report to the federal government about how residential schools damaged Indigenous communities and individuals throughout the 19th and 20th centuries, with recommendations on how to redress the past. The report will mark the culmination of four years of public hearings, statements, survivor testimonials and academic research. Researchers from McGill’s Centre for Human Rights and Legal Pluralism are among those who have contributed. The CHRLP’s participation in such a wide-ranging inquiry exemplifies its belief in engaging directly with real-world issues – and the essential need to view complex issues through multiple lenses.

“Human rights is one of the defining features that gives the Faculty of Law its specific identity,” says the CHRLP’s founding director, René Provost, tracing this lineage to such figures as John Humphrey, who authored the first draft of the Universal Declaration of Human Rights in 1948; poet and professor F.R. Scott; and, more recently, Member of Parliament Irwin Cotler. The Centre has taken that rich tradition of inquiry and connected it to work being done in other disciplines, with the goal of re-conceptualizing human rights. Provost remembers his early years at McGill, and how his academic interactions were largely limited to his own faculty. “Today, I collaborate constantly with people in other disciplines,” he says, referring to research projects and teaching courses with professors in the School of Social Work and the departments of Anthropology and Political Science.

The Centre’s Global Echenberg Conference series on human rights is another example of this boundary-crossing approach to scholarship. As Nandini Ramanujam, executive director of the CHRLP, points out, “the series brought together a cross-section of professors, students, judges, lawyers, politicians, business people, and young leaders from around the world with the aim of bridging academic and pragmatic discussions about human rights. The conferences...
OUR_SOCIETY

“HUMAN RIGHTS IS ONE OF THE DEFINING FEATURES THAT GIVES THE FACULTY OF LAW ITS SPECIFIC IDENTITY”
— RENÉ PROVOST

Yet the Centre is also relentlessly grounded in action. François Crépeau, a law professor and Centre member, was appointed the United Nations Special Rapporteur on the Human Rights of Migrants in 2011. He is charged with examining and protecting the rights of migrants across the globe, and with reporting his findings both to the UN General Assembly and to the Human Rights Council.

In his scholarly work as in his role as Special Rapporteur, Crépeau emphasizes the need to balance competing rights and interests: states need to be able to ensure their own national security, but they also have international obligations. “Western democracies are increasingly caught between accepted rights-based standards of behaviour toward all individuals, and political pressures to effectively and securely control their borders. There is genuine tension between international human-rights law and the exercise of state sovereignty.”

This tension has grown since the events of 9/11, with many states implementing measures that prevent or slow the entry of migrants, resulting in an increase in irregular migration. “Asylum-seekers and refugees are denied access to international protection or returned to territories where their life or freedom is threatened,” he noted, adding that desperate people then rely on informal networks or people-smugglers in their search for a better life, and the states where they end up view their presence as “illegal,” or outside the circle of legality.

“Migration is in the DNA of humankind,” Crépeau said, speaking to the General Assembly in 2011. “It is how we cope with environmental threats, with political oppression, but also with our desire to create a meaningful future for ourselves and our children.” The key, he emphasized, is finding a way to live together and

gave rise to two published books, numerous working papers and a global community of human-rights specialists.

Colleen Sheppard, the current director of the CHRLP, explains that the Centre has endeavoured to integrate scholarship, teaching and community engagement. “They are integrated – our research and engagement with other scholars is central to what we are teaching and to our outreach.”

This integrated approach is also inherent in the Centre’s somewhat complex name: the Centre for Human Rights and Legal Pluralism. Legal pluralism addresses the existence of multiple legal orders, be they formal (international, national, provincial, or municipal law) or informal (religious communities, institutional norms, or indigenous legal norms, to name a few). Human rights, on the other hand, is generally considered a universal concept, with laws that apply globally.

“Juxtaposing human rights with legal pluralism seems, at first blush, contradictory,” Sheppard says. “But the research and scholarship we do re-conceptualizes human rights in these multiple and co-existing legal orders.” As Frédéric Mégret, Centre member and Canada Research Chair in Human Rights and Legal Pluralism, has explained, “a pluralist human-rights agenda seeks to understand how different states or groups within them emphasize different rights (e.g. freedom of expression vs. freedom of religion) and how this creates complex distortions that are as important to human rights as the pursuit of a coherent doctrinal whole.”
adopting rights-based policies that empower individuals to fight for their rights.

Another Centre researcher who exemplifies this blend of scholarly work and active engagement is law professor Adelle Blackett, whose focus on domestic workers has resulted in her engagement as an expert for the International Labour Organization (ILO), where she has helped develop a new standard for the rights of domestic workers.

“The ILO first put the issue of domestic work on their agenda in 2008 and they needed the rationale for a new convention, they needed a report on law and practice around the world, and they needed it in a few months!” Blackett recalled. “A number of McGill students helped out as research assistants and they were tremendous.”

The initiative gave Blackett the opportunity to explore the human-rights aspects of domestic work and to flesh out the notion of “decent work.”

“It was a policy document, not an academic article, and that’s always fun for an academic,” she continued, “to produce a document that’s persuasive, that’s succinct, that isn’t heavily theoretical, but that does draw on theory in constructive ways.” She is also conducting a research project examining why domestic workers’ rights are so difficult to protect, and chronicling “simple, supportive and smart” examples of regulatory innovation in that area.

Indeed, Blackett’s work has had an influence on policy, not only on an international scale but also here in Quebec as a member of the provincial Human Rights and Youth Rights Commission that has issued reports on migrant domestic and agricultural workers’ rights.

“These researchers, and much of the work at the Centre, asks what human rights mean and how to ensure that human rights do not exist only on paper only but are actualized in everyday life,” Sheppard says.

It’s the chance to make that kind of real-life impact that drew Sheppard and her colleagues to the Truth and Reconciliation Commission. She submitted a paper about systemic discrimination: how attitudes of racial supremacy may result in ongoing harms both for residential-school survivors (in terms of health problems, problems of addiction, and problems of violence and domestic violence) and in Indigenous communities more broadly. Professor Kirsten Anker explored the meaning of reconciliation itself, including how to acknowledge past wrongs and address them. Professor Mark Antaki examined reconciliation discourse in Canadian constitutional law. Their research brings a nuanced perspective on human rights to the work of the Commission and continues the Centre’s work in bridging theoretical concepts and everyday life.

This undertaking is as important in a local context as in an international one, Sheppard points out. “We sometimes think about human rights only with respect to faraway places or developing countries. As a Centre, we feel that it is important to recognize that there are also some fundamental and critical human-rights issues that need to be addressed in Canada.”

The Centre for Human Rights and Legal Pluralism receives funding from many donors, including Mr. David O’Brien and the Nussia and André Aisenstadt Foundation.

Top left: Adelle Blackett, top right: François Crépeau, bottom left: Colleen Sheppard, bottom right: René Provost.
It’s a sobering statistic. Countries in the Asia-Pacific region alone will have to increase their food production by 77 per cent by 2050 in order to feed their people, according to a recent report by the Food and Agriculture Organization.

This is a figure that worries Chandra Madramootoo (pictured right), especially given the increasing threat extreme weather poses to crops. Madramootoo, dean of the Faculty of Agricultural and Environmental Sciences at McGill and founding chair of the annual McGill Conference on Global Food Security, launched in 2008, spoke to Headway about the various avenues researchers around the world are looking at to try to feed a growing world population.

**WHAT ARE SOME OF THE CURRENT CHALLENGES RELATED TO FOOD SECURITY AND PRODUCTION?**

Climactic extremes brought about by climate change, such as floods and drought, are one of the major challenges to producing enough food. Predictions by the United Nations Environment Program indicate that extreme drought and heat will be responsible for some of the largest losses in cereal production by 2080, in particular in Africa and Asia.

But there is also a very limited land base available for the expansion of food production. There are potentially 45 to 50 million hectares that could be used, but these are mostly areas that have poor soils and limited road access or that are ecologically fragile.

**AREN’T WE GROWING MORE AND MORE FOOD?**

Crop yields are a major area of concern. From the early 1960s to the late 1980s, we saw strong increases in crop yields, thanks to new high-yielding varieties of cereals, but over the past 20 years, that growth has dropped dramatically. For example, the increase in wheat yields has dropped from an annual average of 2.75 per cent to 0.5 per cent. And these numbers are a global average, so they include high-producing regions like the midwestern United States. In developing regions of the world, particularly in Africa, crop yields are declining.

**WHAT ARE SOME OF THE WAYS THESE CHALLENGES ARE BEING ADDRESSED?**

One of the ways crop yields can be improved is through irrigation, which has enormous potential. At the moment, irrigated land represents about 20 per cent of all cropland, yet it produces 40 per cent of the world’s food. By comparison, about 80 per cent of cropland is rainfed but produces only 60 per cent of the planet’s food. Developing improved irrigation systems presents its own challenges though: the African continent is endowed with significant water resources, but, unfortunately, for political, financial or logistical reasons, these countries are often unable to tap into their irrigation potential. A lot of water resources are subject to transboundary agreements, for example. And irrigation depends on enormous infrastructure investments that many governments just don’t have the capacity to support.
HOW IS TECHNOLOGY HELPING US IMPROVE FOOD SECURITY?

Technology is helping in many ways. It can alleviate the physical demands involved in the production of certain cereals and help people grow more palatable or more nutritious food. It can inform decisions that lead to better crops (see “Smartfarming” on page 30). Improved crop genetics are also a promising avenue. A lot of efforts are focused on developing new cultivars that can handle pests and disease, as well as environmental stresses - water, drought, heat – generated by our changing climate. Once we identify the traits we want and breed new varieties, we must then have mechanisms in place that allow these new cultivars to be replicated and reach farmers. Maize has been a great success story in that regard, going from seven varieties before 1970 to 455 varieties being used in Eastern and Southern Africa today. The private sector played a major role in getting these varieties out to producers. It’s important for governments and the private sector to work together in order to improve the delivery of modern varieties of seeds to farmers.

WHAT ELSE SHOULD GOVERNMENTS KEEP IN MIND?

The non-agronomic side of food production - markets, policies, education and training, and infrastructure - has played an increasingly important role in global agricultural productivity growth since the 1960s. In fact, these elements have largely outweighed the agronomic factors in most of the world, except in Asia. If we want to make significant productivity gains in the next decades, the challenge now is to maintain that success at the same time as we try to increase crop yields.

Above: Ploughing fields in India
Right: Cattle grazing in the Sahelian drylands of Senegal
Bottom right: Harvesting rice in China
Data from the United Nations Food and Agricultural Organization (FAO) indicate that, worldwide, about 800 million people suffer from undernourishment. But these numbers don’t provide the whole picture of food insecurity, according to Dr. Hugo Melgar-Quinonez (pictured above), director of the McGill Institute for Global Food Security.

“Based on the amount of food available for consumption in a country, the FAO estimates whether it meets the caloric needs of its population,” he says. “But this estimation is based on a sedentary lifestyle, so it is the ‘more optimistic’ scenario. In rural areas, or where livelihoods depend on more physical work, the caloric needs are higher, so the magnitude of the problem could be larger.”

Furthermore, this indicator does not take into account the nutritional quality of the food available. As Melgar-Quinonez points out, “people would die very quickly if they only ate white bread or white rice.”

The nutrition expert, who is also a medical doctor, points out that 1.5 billion people are iron deficient and a third of the world population is deficient in zinc, two nutrients that are “key for life and for immune function.”

But a new way of measuring food insecurity could help develop a more comprehensive picture of food insecurity in the world. The FAO project Voices of the Hungry uses a questionnaire, which, integrated into the Gallup World Poll, is administered in more than 150 countries. The questionnaire is modelled on the Latin American and Caribbean Food Security Scale, applied in some 20 countries by Melgar-Quinonez and colleagues, and based on a tool used in the United States and Canada since the late 1990s.

The experience-based scale includes eight questions, that ask people about the variety and nutritional quality of their food, and whether, in the last 12 months, they had to skip meals or ran out of food. Included every year, it will provide a measure of the level of severity of global food insecurity.

“If you want to help hungry people, you need to know who they are and where they are,” adds Melgar-Quinonez, who served on the advisory group of the Voices of the Hungry project. “This project allows the application in a fast and affordable way and in a majority of countries – including in places where food security has never been measured – of a valid and reliable instrument.”

Through Melgar-Quinonez’s collaboration with the FAO, McGill has been given a licence to access the complete data sets of the Gallup World Poll. “This gives us access to an immense amount of data on determinants or consequences of food insecurity. It offers many possibilities of research avenues to pursue, which our graduate students are exploring in the new McGill Global Food Security Data Laboratory.”
Viacheslav (Slava) Adamchuk describes himself as an information-technology enthusiast. The bioresource engineering researcher in McGill’s Faculty of Agricultural and Environmental Sciences spends a lot of his time designing a sleek fleet of gadgets that gather, and make sense of, a wealth of data. But instead of building the latest personal infometrics app that counts daily footsteps, or keep tabs on caffeine consumption, Adamchuk focuses his obsession on creating tools to help farmers collect indispensable information about their soils and crops.

Canada is the fifth-largest agricultural exporter in the world, and the agriculture and agri-food industry employs one in eight Canadians. This important sector depends on soil: too dry and crops go thirsty; too low on nutrients and crops starve. The conditions are not only crucial, but they can vary within the same field. One of Adamchuk’s devices is a real-time soil-moisture sensor that attaches to a planter. As a tractor pulls the planter through a field, the sensor measures variations in the soil’s moisture levels – information the planter uses to adjust, on the fly, how deep to sow each seed in order to optimize crop yields. Similar proximal soil-sensing gadgets are used throughout the growing season, to help farmers decide where to irrigate – a decision that’s especially important in drought-like conditions, where every drop of water is precious.

A crop’s success, however, doesn’t just depend on water. Early in his career, Adamchuk developed a sensing system that maps pH levels to gauge whether soil is too acidic or alkaline. Those levels affect how well a plant can absorb nutrients. When soil is too acidic, farmers might add lime; having a detailed soil pH map helps them to know exactly where to apply the mineral. In 2003, the Kansas-based company Veris Technologies Inc. used Adamchuk’s system as the backbone of its Soil pH Manager on-the-go probe, which takes readings as it is pulled through a field. The device delivers much more detailed pH readings than traditional sampling; the system remains the only product of its kind on the market, Adamchuk says, and is now used around the world.

Adamchuk has also developed on-the-go prototypes for other measurements, including soil apparent electrical conductivity profiling, optical reflectance, and mechanical resistance. Apparent electrical conductivity is a good indicator of soil’s water- and nutrient-holding capacity, which in turn is a good predictor of potential crop yields. Conductivity, however, can be influenced by many soil attributes – such as texture, salinity, organic matter, or moisture – meaning two fields could have an identical sensor reading but for different reasons. Knowing the precise factors contributing to these differences helps farmers make better crop-management decisions. Adamchuk is now looking into combining different measurements into a single sensing instrument, in addition to a processing system that integrates those data with historical maps, and satellite and aerial imagery.

“Our goal is to build the equivalent of a Mars rover designed for Earth, for land,” he explains. A Swiss-Army knife of a system, that uses different precision tools for different measurements, could be used by farmers and other managers of natural systems to obtain a sophisticated view of every aspect of a specific little patch of our planet. There’s only one key difference between Adamchuk’s hardware and Mars Curiosity: “Instead of looking for ‘new’ life, we are looking for ways to make existing life sustainable.”

Viacheslav Adamchuk’s research is funded by the Natural Sciences and Engineering Council of Canada, the Canada Foundation for Innovation, Agriculture and Agri-Food Canada, John Deere and the National Science Foundation.
A bird’s-eye view of Quebec’s Montérégie region reveals a hodgepodge of woodlands cleaved by roads, farmland and residential hot spots. These “green islands” which dot the region are one of the richest providers of what researchers call “ecosystem services” – such things as maple and fruit production, habitat for pollination by wild bees, carbon storage and space for a variety of recreation activities.

But the fact the green islands are sparse and unconnected is cause for concern, and can present a serious challenge to the biodiversity of the region, which has not always looked as it does now; the number and nature of those “green islands” has fluctuated through time as the result of such human activities as agriculture and urban growth.

As a McGill graduate student, Martine Larouche recently conducted historical studies of the region’s landscape and found that gradual deforestation due to the expansion of agricultural lands over 140 years has resulted in a loss of 36 per cent of the forests, and that 67 per cent of the forest patches have become isolated over time. Their isolation results in fragmented habitats – unconnected waterways and isolated woodlands – for the species that live there, threatening their survival.

The Montérégie is now the most populated region in Quebec outside of Montreal; it includes increasingly dense cities and towns on the St. Lawrence River’s south shore, just across from Montreal, as well as smaller rural towns and agricultural lands stretching to the U.S. border. New pressures are mounting for municipalities to support road construction and residential development, further threatening the biodiversity and the ecosystem services that urban dwellers covet. Surprisingly little is known, however, about managing habitats for the many services ecosystems provide.

Larouche’s studies are part of the Montérégie Connection research initiative, led by Elena Bennett, of the McGill School of Environment and the Department of Natural Resource Sciences; Martin Lechowicz and Andrew Gonzalez, of McGill’s Department of Biology; and Jeanine Rhemtulla, formerly of McGill’s Department of Geography (now at the University of British Columbia). These researchers have spent the past five years researching the linkages between ecosystem services, biodiversity, and land use. “Connectivity” is the key word that binds.

“Connectivity, for me, is the fundamental goal of this project – to demonstrate its importance in the real world, not just in a mathematical model,” says Gonzalez.

In a fragmented landscape, species will encounter very real problems moving over land and water, an issue aggravated by fluctuating climates. “Under climate change, species are moving...
up from the south, and down from the north. A bird can fly over the
city—if it can avoid the skyscrapers—but if you are a frog you need
pathways,” says Lechowicz.

When forest links are made, not only is the biodiversity of an
area conserved, but there is great potential to enhance the
multifunctional use of agricultural landscapes. In one of the first
empirical studies of the effects of forest fragments on the simul-
taneous provision of multiple ecosystem services, Matthew
Mitchell, a recent McGill doctoral graduate, with Bennett and
Gonzalez, observed that crop fields adjacent to forest edges can
benefit from the supply of insect predators (like ladybugs) that
control aphid pests known to reduce crop yield.

In another study by Kyle Martins, whose MSc was co-supervised
by Gonzalez and Lechowicz, it was demonstrated that by preserv-
ing meadow and forest patches adjacent to orchards, producers
could rely on wild bees for pollination. As domestic bee populations
continue to decline in Quebec and Ontario, this option for manag-
ing the landscape to maintain the connectivity of different
ecosystems takes on new significance for agricultural producers.

CONNECTING WITH THE COMMUNITY

Supported by Lechowicz’s longstanding ties in the
region (from 1995 to 2011 he served as director
of McGill’s Gault Nature Reserve, a private estate
donated to McGill in 1958 with the stipulation its forested landscape
be preserved), the McGill researchers, together with municipal
leaders and other stakeholders, are developing scenarios about
possible futures for the region, designed to promote further dialogue
on sustainability in the Montérégie [see sidebar].

In October 2014, Bennett and her team met with a municipal and
provincial advisory board to present scenarios or “stories” that
have emerged from concerns stakeholders have about the future
of the region and its ecosystem services. These “ecological trajecto-
ries” provide community members with concrete examples of the
long-term effects of land change and development.

Kees Vanderheyden, director of the Mont Saint-Hilaire Nature
Centre, one of the project’s many partners, sees the stories as
tools to inspire discussion about pressing questions, such as: What
will be the long-term impact on the ecosystem if we pursue the
development of a highway or a commuter bridge in a particular
municipality? “It’s tough to explain when things are far away in
time,” he says. “We have to bring these ecological issues to light,
and make it personal.”

Bennett says the engagement of the partners with the stories
and their implications is “heartwarming.” “[At this meeting,] I
looked around the room and people were literally sitting on the
edge of their seats. They were asking themselves and each other—
what do we want for the future of our region and what message
do we want to send about how to achieve that future?”

There is a good reason for the municipal leaders to consider
seriously what actions to take. Recent provincial legislation calls
for all municipalities to update their natural-environment and
landscape-management plans within the next five years.
Bernard Morel, the director of the Land-Use and Environmental Planning Department at the municipality of Mont-Saint-Hilaire, says the community is concerned about protecting the biodiversity of the region, including the woodlands. “The researchers have sensitized the community to the science behind the need to preserve and connect the woodlands,” he says. “The communities have been able to take this knowledge and modify their approach, allowing us to begin putting in place plans for our most-hoped-for scenario.”

The Montérégie Connection Project has been supported by funding from the Natural Sciences and Engineering Research Council, Ouranos and the Max Bell Foundation.

Top left: McGill student Katriina O’Kane measures the diameter of a tree, which is then used to calculate carbon storage.

Bottom left (left to right): Graduate student Carly Ziter and undergraduate students Claudia Atomei and Katriina O’Kane walk to a field site to measure carbon storage and biodiversity.

Above: PhD student Dorothy Maguire collects insects in a tree canopy.

Based on their consultation with Montérégie municipal leaders and other stakeholders, McGill researchers have identified these four scenarios as potential future land uses in the region:

**PERI-URBAN DEVELOPMENT:** A significant population increase inspires the construction of four new residential neighbourhoods. A new bridge is built in the eastern part of Montreal in 2030, expanding residential growth in the northern towns of the Montérégie. Urban development demands further deforestation and diminished agricultural activity in certain regions. Agro-tourism is threatened.

**DEMAND FOR ENERGY:** To mitigate rising energy costs, shale gas exploitation is undertaken, wind turbines are installed and options for hydroelectricity production are explored; forests are felled for wood in the northern sectors. To halt rising water levels, a partial canal is installed in the Richelieu River. Employment rises, as do taxes. Agricultural production decreases, and climate changes increase.

**WHOLE-SYSTEM CRISIS:** Rising household debt drives housing prices down. An aging population puts a strain on services and limits employment opportunities. Single-family homes are converted into condos. The Asian longhorned beetle invades, decimating the maple population. Deforested land is converted for agriculture, or left fallow. Intensive farming is undertaken for export. Little investment in electric transport (trams) is made.

**GREEN DEVELOPMENT:** There is a political shift toward sustainable development. Renewable energies such as wind and solar power are prioritized, as are investments in bike pathways and green tramways. Employment is on the rise. Reforested farmland in the north provides maple products, recreation and mushroom crops. Seventeen per cent of the land is protected from development by 2035. What development is undertaken focuses on sharing resources.
EMERGING STARS //

Two of McGill’s up-and-coming researchers, Jonathan Davies and Brett Thombs, were awarded the newly established Principal’s Prize for Outstanding Emerging Researchers in 2014. The prize was created to honour researchers in the early stages of their careers, within 10 years of being awarded their highest degree.

By Meaghan Thurston

JONATHAN DAVIES

Jonathan Davies is a biodiversity scientist who is looking back to see ahead. An emerging research leader in phylogenetics – approaches in biology that help researchers visualize evolutionary relationships and develop hypotheses about the evolutionary history of species groups – he is focused on the accelerating effects of climate change on species and ecosystems in an increasingly transformed and human-dominated landscape, as well as on identifying the best opportunities for conservation.

Recent work Davies conducted with researchers from the United States, Canada, Sweden and Switzerland, and published in *Nature*, revealed that scientists might have dramatically underestimated how plants will respond to climate change in the future – some plants are flowering up to eight times faster than ecological models anticipated.

Davies, an assistant professor in the Department of Biology, is also seeking to unite two disparate areas of inquiry aimed at understanding the variation in the numbers of species across the globe: numerous studies have sought explanations for why some taxa, such as grasses or orchids, contain more species than others – sometimes referred to as taxonomic imbalance – concentrating on the role of key biological traits such as pollination syndrome or the mode of seed dispersal. These traits have been shaped over millions of years through natural selection. On the other hand, ecological studies that have explored differences in floristic richness among regions have typically focused on environmental predictors, such as temperature and rainfall, but have not traditionally addressed evolutionary explanations.

Phylogenetics offers a powerful means to combine both approaches. “A better understanding of the past can help inform discussions on how we should manage for the future,” he says, noting that species function within ecosystems, and therefore we should not study them in isolation, but rather we must also consider the complex web of interactions that link them together - Darwin’s tangled bank.

BRETT THOMBS

Brett Thombs’s work focuses on improving the mental health and quality of life among patients with rare diseases. More broadly, he is dedicated to producing research that helps provide better patient-centered care for all people living with a chronic illness. He is a senior investigator at the Lady Davis Institute for Medical Research at the Jewish General Hospital and an associate professor in the Department of Psychiatry at McGill’s Faculty of Medicine.

Thombs is also the founder and director of the Scleroderma Patient-Centered Intervention Network, a collaboration of key scleroderma research centres, patient organizations, and experts in clinical trial methods from around the world. Scleroderma is a group of rare diseases (fewer than 16,000 cases in Canada) that involve the hardening and tightening of the skin and connective tissues that provide the framework and support for the human body.

“Psychosocial, educational, and rehabilitation interventions – for example, programs to improve coping with emotional distress, and exercise-based programs to maintain physical function – play an important role in limiting disability and improving quality of life for people with many chronic diseases,” says Thombs. “Such interventions, however, are typically not available for people with rare diseases, largely due to the difficulty in conducting clinical trials with enough participants to confidently assess results.”

In addition, Thombs is making a name for himself in two inter-related research areas: the evaluation of mental-health service programs, focusing on depression screening in medical settings and among patients with chronic illnesses, and the examination of how medical research is conducted, with the aim of improving methods and reducing bias.
## PRIZES

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<tr>
<th>PRIZE</th>
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<td><strong>KAVLI PRIZE</strong></td>
<td>BRENDA MILNER (The Neuro)</td>
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<td><strong>KLAUS J. JACOBS PRIZE</strong></td>
<td>MICHAEL MEANEY (Douglas Institute)</td>
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<td>NIGEL ROULET (Geography)</td>
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<td>PETER S. MCPHERSON (Neurology and Neurosurgery/Anatomy and Cell Biology)</td>
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<td>CONSTANTIN POLYCHRONAKOS (Pediatrics)</td>
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<td>DANIEL WISE (Mathematics and Statistics)</td>
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<td><strong>COLLEGE OF NEW SCHOLARS, ARTISTS AND SCIENTISTS</strong></td>
<td>AASHISH CLERK (Physics)</td>
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<td>MADHUKAR PAI (Epidemiology)</td>
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<td><strong>MCLAUGHLIN MEDAL</strong></td>
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<td>PAUL LASKO (Biology)</td>
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<td>MICHAEL MEANEY (Douglas Institute)</td>
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<td><strong>SSHRC IMPACT CONNECTION AWARD</strong></td>
<td>NICOLAS LEROY (Social Work)</td>
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<td><strong>QUEBEC SCIENCE DISCOVERIES OF 2014</strong></td>
<td>Unbreakable glass: FRANÇOIS BARTELAT (Mechanical Engineering)</td>
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<td>Gene variant that protects against Alzheimer’s disease: JUDES POIRIER (Douglas Institute)</td>
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<td>Tiny molecule that may provide a marker for depression: GUSTAVO TURECKI (Douglas Institute)</td>
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## AWARDS AND FUNDING

- In January 2015, world-renowned green chemist ROBIN ROGERS joined McGill as **CANADA EXCELLENCE IN RESEARCH CHAIR IN GREEN CHEMISTRY AND GREEN CHEMICALS**, a $10-million grant from the Government of Canada.
- ANDREW PIPER of the Department of Languages, Literatures, and Cultures will share a funding pool of approximately $5.1 million as part of the third round of the **DIGGING INTO DATA CHALLENGE**, an initiative funded by several organizations, including the Canada Foundation for Innovation, the Natural Sciences and Engineering Research Council and the Social Sciences and Humanities Research Council.
- ZETIAN MI, Department of Electrical and Computer Engineering, and YIXIN SHAO, Department of Civil Engineering, were among the 24 winners of $500,000 grants to transform carbon dioxide into useful products as part of the Alberta-based **CLIMATE CHANGE AND EMISSIONS MANAGEMENT CORPORATION** Grand Challenges program.
- DAN DECKELBAUM, Divisions of Trauma and General Surgery at the MUHC, SCOTT BOHLE, Department of Chemistry, and MADELEINE BUCK, of the Ingram School of Nursing, received funding for global health projects from the **GRAND CHALLENGES CANADA** program, funded by the Government of Canada.
- The Government of Canada announced funding of up to $6.2 million over the next five years to support the launch of **CENTRE D’ENTREPRISES ET D’INNOVATION DE MONTRÉAL (CEIM)**’s Innovation Québec project, a key element of which is an innovative partnership between CEIM and McGill to support entrepreneurship.
- ARUJIT NANDI, Institute for Health and Social Policy, with partner organizations in India, and SHELLEY CLARK, Department of Sociology, were awarded grants of more than $1 million each through the **INTERNATIONAL DEVELOPMENT RESEARCH CENTRE: GROWTH AND ECONOMIC OPPORTUNITIES FOR WOMEN PROGRAM**.
- **E.W.R STEACIE MEMORIAL FELLOWSHIPS**
  - EHAB ABOUHEIF (Biology)
  - AASHISH CLERK (Physics)
- **TRudeau FELLOWSHIP**
  - MYRIAM DENOV (Social Work)
- **KILLAM FELLOWSHIP**
  - LIONEL SMITH (Law)
- **SLOAN RESEARCH FELLOWSHIP**
  - SIMON GRAVEL (Human Genetics)
The first cover of Headway, in 2005, featured McGill astrophysicist Vicky Kaspi. The Canada Research Chair in Observational Astrophysics and her team had recently discovered 20 pulsars in a single star cluster in the Milky Way. Pulsars are a type of neutron star—a dense remnant of a collapsed massive star—that spin at staggering speeds, generate strong electromagnetic fields and emit beams of radio waves.

Only 10 years later, Kaspi and her team have made several other major breakthroughs, including detecting the fastest-rotating pulsar ever found and verifying Einstein's theory of general relativity by observing a twin-pulsar star system (two pulsars locked into close orbit around one another): they confirmed that the spin axis of one of the pulsars does “wobble”, as predicted.

Headway caught up with Kaspi, who holds the Lorne Trottier Chair in Astrophysics and Cosmology at McGill, to discuss what she's looking into now.

YOU HAVE A SABBATICAL LEAVE COMING UP. WHAT WILL YOU BE WORKING ON?
McGill – through the leadership of my cosmologist colleague Matt Dobbs – is participating in the Canadian Hydrogen Intensity Mapping Experiment (CHIME), a radio telescope designed to study dark energy, which is believed to be responsible for the acceleration of the expansion of the universe. CHIME will allow us to study large swaths of the sky at the same time and gather huge amounts of data, including on radio pulsars. We'll be able to study many pulsars at any one time 24 hours a day. This could help us detect gravitational waves, distortions in space time caused by the motions of large masses in the universe, a phenomenon predicted by Einstein's theory of general relativity but never confirmed.

YOU WERE THE PRINCIPAL INVESTIGATOR ON A PROJECT THAT RECENTLY LED TO THE DISCOVERY OF A “FAST RADIO BURST” DETECTED BY THE ARECIBO OBSERVATORY TELESCOPE IN PUERTO RICO, AND WHICH CONFIRMED THAT THESE BURSTS REALLY ARE OF COSMIC ORIGIN. WHAT’S NEXT ON THAT FRONT?
Only half a dozen of these millisecond bursts have been detected so far but we estimate that they occur about 10,000 times a day. There is strong evidence suggesting that they are coming from far outside our galaxy, so they must be really bright phenomena. With CHIME, we should be able to see quite a few every day, so it will help us understand them better. Because at the moment, we have no idea what is causing them.

THE ASTROPHYSICS GROUP AT MCGILL HAS GROWN A LOT IN THE PAST 10 YEARS. TELL US ABOUT THE NEWLY CREATED MCGILL SPACE INSTITUTE (MSI).
The goal of the MSI is to bring together everyone at McGill who is doing space-related research, beyond just astrophysics. For example, an exciting research avenue right now is extrasolar planets (planets that do not orbit the Sun) and that is an area where astrophysics intersects with research pursued in other departments, such as Earth and Planetary Sciences or Atmospheric and Oceanic Sciences. The MSI will help foster interdisciplinary collaborations and keep our research directions fresh.

Since 2005, Vicky Kaspi has received the Natural Sciences and Engineering Council of Canada (NSERC)’s Steacie Prize and John C. Polanyi Award, as well as additional funding from NSERC, the Canada Foundation for Innovation, the Fonds de recherche du Québec – Nature et technologies, the Canadian Institute for Advanced Research and CANARIE. CHIME is funded in part by the Canada Foundation for Innovation.
**FUNDING FACTS //**

**FACULTY**

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<td>173</td>
<td>Endowed teaching and research chairs</td>
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<td>157</td>
<td>Canada Research Chairs allotted to McGill</td>
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<td>156</td>
<td>Active members of the Royal Society of Canada</td>
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**RESEARCH**

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<td>government- and industry-sponsored RESEARCH CONTRACTS valued at MORE THAN $17 MILLION in 2013-14 (excluding affiliated hospitals)</td>
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<td>64</td>
<td>LICENCES and options to license granted to the private sector from 2011-14, for a cumulative total of 173 ACTIVE LICENCES</td>
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**MCGILL HAS A SIZEABLE PATENT ESTATE** available for licensing:

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<tr>
<td>42</td>
<td>national and international PATENTS granted to McGill in 2013-14</td>
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**RESEARCH FUNDING 2012–13**

**[INCLUDING AFFILIATED HOSPITALS*]**

**TOTAL: $465.2 M**

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<td>INTERNATIONAL AND OTHER GOVERNMENTS</td>
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<td>INDIVIDUALS</td>
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* Includes the McGill University Health Centre; the Jewish General Hospital (Lady Davis Institute); the Jewish Rehabilitation Hospital; the Shriners Hospital; the Douglas Mental Health University Institute; and St. Mary’s Hospital Center.
HOW DOES CHILDHOOD ABUSE REWIRE YOUNG BRAINS—AND PUT VICTIMS AT INCREASED RISK FOR DEPRESSION AND SUICIDE? Michael Meaney’s lab was the first in the world to show that mistreatment actually changes children’s DNA, and those changes can be for life. In December 2014, he received Switzerland’s prestigious Klaus J. Jacobs Research Prize in recognition of his curiosity and creative problem-solving, which is opening the door to preventing childhood and adult mental health problems.

CONGRATULATIONS, PROFESSOR MEANEY, ON WINNING THE 2014 JACOBS RESEARCH PRIZE.