Research Matters

IN THIS ISSUE: mobilizing our knowledge
Welcome

Great research builds strong communities. It is the foundation for growth — socially, culturally and economically. McMaster has been at the forefront of great research for some 125 years now and, since our move to Hamilton in 1929, we have become an integral part of the community and have been instrumental in helping to grow the economy.

Research is a key driver in any economy and it is our responsibility to ensure the broader society reaps the benefits of our research. That’s why we are so committed to knowledge mobilization and technology transfer. It’s our goal to get the right information — whether a creative idea of a new technology — into the hands of the right people in order to inform policy and decision-making or develop a new product, so the greatest number of people benefit.

In this issue, you’ll meet a number of our researchers who are committed to sharing their knowledge. Their passion and commitment to their research is second to none and their work is transforming how people live, work and play. Simply put, their research matters because you do.

Mo Elbestawi
Vice-President, Research & International Affairs

On the cover: Sue Becker, Professor in the Department of Psychology, Neuroscience and Behaviour, in the Atrium of McMaster Innovation Park – the location of VitaSound Audio Inc., which manufactures hearing aids developed by Becker and her McMaster colleagues.

INQUIRE

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It always appears on the list of life’s most stressful events, rounding out a top ten that includes death, divorce and losing your job. A change in residence – moving house – is never a welcome task and no one knows this better than the Canadian Association of Movers (CAM).

The CAM is in the business of assisting consumers access credible, professional moving services, and they know that one of the best ways for a reputable moving company to offer their services is on the “information highway” via the World Wide Web.

When the Association wanted to help their membership learn how best to build trust on the Internet, they invited Milena Head to their annual conference, to the success of any company doing business on the Web – the information she was able to share with the Canadian Association of Movers with her invited presentation “Building Trust on the Internet.”

“While academic knowledge may be public, it is not easy to use by non-professionals,” Head acknowledges. “Not everyone knows where they can access a professional journal, or even realizes that there’s research that’s been done and articles written that might be of use for a business to expand their customer base, promote sales, improve customer service or provide a secure online environment for their clientele.”

Head has long been a keen participant in what’s been described as knowledge mobilization: moving knowledge into active service for the broadest possible common good. Beyond her role as a researcher and educator, Head has delivered dozens of public lectures and invited talks to professional organizations and service groups on subjects that range from identity theft to the usability of mobile devices. The business professor knows what makes good eBusiness sense, and she’s packaged her research results in a way that’s accessible and usable for non-academic audiences.

What does Head see as one of the next challenges on the horizon for Canadian businesses and consumers?

“The adoption of biometrics for everyday transactions has not yet been embraced by the Canadian public,” says Head. “Compared to many other countries, we’re lagging behind in the use of biometric systems to counter identity-related issues and bank fraud. The question is, are Canadians ready to move to this new technology?”

The Office of the Privacy Commissioner of Canada defines biometrics as “a range of techniques, devices and systems that enable machines to recognize individuals, or confirm or authenticate their identities.”

Identity-management systems range from the biometric chip in Canadian passports that “locks in” the photo of the passport holder, to palm scanners in Japan that identify the unique “signature” of the user by the veins in their hands. Grocery stores in the U.S.A. are using biometric payment technology based on a fingerprint scan and iris recognition has been used around the world since the 1990s.

Whether it’s the branching blood vessels in a hand, the texture and pigment of an iris, or the swirls and ridges of a fingertip, Canadians are wary of how their unique identifiers will be collected, used and stored.

But when you consider that Canadians are among the biggest per capita users of debit cards in the world, and in 2011 alone the Canadian Fraud Centre reported more than $13-billion lost by identity fraud victims, it’s clear that convenient, secure, cost-effective options for protecting identities, bank, and online business transactions needs to be explored.

It’s a multi-faceted area with a variety of issues that will benefit from the research undertaken by researchers like Milena Head. Better yet? When that research is mobilized and shared to help build value for Canadians.
New business venture to commercialize stem cell technologies

McMaster University and Actium Research Inc. have signed an agreement that will allow Actium to address the need for better drugs targeting cancer stem cells and regenerative medicine.

Scientific Director of the McMaster Stem Cell and Cancer Research Institute (SSRCI) Mick Bhatia says the agreement, which covers McMaster’s proprietary human stem cell lines, cancer stem cells and platforms developed by SSRCI researchers, is exactly what’s needed to accelerate the movement of his team’s research discoveries into the marketplace.

Actium Research Inc. is a drug discovery and development company targeting both cancer stem cells to improve survival and health outcomes, and normal tissue stem cells to promote healing and help discover cures in chronic disease. It was founded by David Young and Helen Findlay – the same duo who founded ARIUS Research Inc. – one of Canada’s most successful biotech companies. Bhatia has been named Actium’s founding scientific director.

More at: actiumresearch.com

Mick Bhatia – Canada Research Chair in Human Stem Cell Biology

Greek letter IQ

IQ research matters

MICK BHATIA Drug destroys human cancer stem cells but not healthy ones

Imagine having access to a cancer-fighting treatment that doesn’t come with the toxic side effects of conventional treatments, like chemotherapy or radiation. Thanks to Mick Bhatia and a team of researchers at the McMaster Stem Cell and Cancer Research Institute, we’re on the brink of exactly that.

Bhatia, alongside his team of scientists, has discovered that the drug known as thioridazine can successfully kill cancer stem cells while leaving the normal, healthy cells relatively unscathed. However, for Bhatia, that’s not even the most intriguing part of the discovery.

“The unusual aspect of our finding is the way this human-ready drug actually kills cancer stem cells by inducing differentiation,” he says. “It changes them into cells that are non-cancerous.”

The research was published in the May 24, 2012 issue of the science journal *CELL*.

The innovation is the next step in Ontario’s role in the discovery of the link between cancer and stem cells. It was back in 1997 that researchers at the University of Toronto first discovered cancer stem cells in certain types of leukemia. Today, they’ve been identified in blood, breast, brain, lung, gastrointestinal, prostate, and ovarian cancers.

Bhatia, as the principal investigator for the study and the scientific director of the McMaster Stem Cell and Cancer Research Institute of the Michael G. DeGroote School of Medicine, believes the new finding holds the promise of bringing to life a new strategy and discovery pipeline for the development of anti-cancer drugs in the treatment of various cancers. In fact, the team has identified another dozen drugs that have good potential for a similar response.

To flesh out the promise, McMaster researchers have already pioneered a fully automated robotic system to identify several drugs, including thioridazine, and their effects not only on cancerous stem cells, but on normal ones as well.

“Now we can test thousands of compounds,” Bhatia says. “Eventually, we’ll be able to define a candidate drug that has little effect on normal stem cells but kills the cells that start the tumour.”

Once that’s been established, Bhatia says the next step is to test thioridazine in clinical trials, focusing on patients with acute myeloid leukemia whose symptoms have relapsed after chemotherapy. He wants to determine whether or not, by targeting cancer stem cells – the root of the problem – the drug can prevent the cancer from coming back.

The wheels are already in motion. Bhatia’s team at McMaster has found that thioridazine works through the dopamine receptor on the surface of the cancer cells in both leukemia and breast cancer patients. This means that it may be possible to use it as a biomarker that would allow early detection and treatment of breast cancer and early signs of leukemia progression too.

The team’s next steps will be to investigate the effectiveness of the drug in other cancers; explore several other drugs identified along with thioridazine; and begin to analyze thousands of other compounds using McMaster’s robotic stem cell screening system – the latter, in partnership with academic groups as well as industry.

“The goal for all of the partners is the same,” Bhatia says. “We all want to find unique drugs that will change the way we tackle and treat cancer.”

The research was funded by the Ontario Consortium of Regenerating Inducing Therapeutics (OCRiT), which is an arm of Ontario’s Ministry of Economic Development and Innovation, the Canadian Institutes of Health Research, the Canadian Cancer Research Institute, and private donors. Bhatia says such a large scale research endeavour would have been impossible without their support and vision.
Researcher Henry Giroux sees a battle being fought between private interests and public values in society. And if the former continues to attack the latter, he worries democracy will be the eventual casualty.

A professor in McMaster’s Department of English and Cultural Studies, Giroux is the Global Television Network Chair in Communications. A prolific and internationally known author with several hundred articles and more than fifty-five books to his name, he was named one of the world’s “Fifty Modern Thinkers on Education” in 2002. Moreover, earlier this year, he was included in the Toronto Star’s list of “12 Canadians Changing The Way We Think.”

An advocate for a more democratic culture and informed citizenry, Giroux is one of the founding theorists of critical pedagogy, an educational movement that emphasizes social justice, focuses on the educational force of the wider culture, connects learning to social change, and examines the power dynamics that reproduce contemporary social and economic institutions. According to Giroux, those power structures are increasingly skewed against people on the margins of society – in particular, poor minorities and low-income young people.

With the rise of a crippling hyper-individualism and pervasive consumerism, we are losing sight of the importance of the public good, public values and the meaning of social responsibility,” explains Giroux. “For instance, instead of seeing poverty as a consequence of systemic inequalities and problems that we must work together to address, we think it’s an individual’s own fault for being poor.”

“With the rise of a crippling hyper-individualism and pervasive consumerism, we are losing sight of the importance of the public good, public values and the meaning of social responsibility,” explains Giroux. “For instance, instead of seeing poverty as a consequence of systemic inequalities and problems that we must work together to address, we think it’s an individual’s own fault for being poor.”

This ideological narrow and privatized view, he goes on, often leads to a number of injurious outcomes. First, disadvantaged groups are seen as “disposable.” Second, those communities are collectively demonized. Third, public values are displaced by commercial values along with a growing disparity in wealth and income. And the result is that too often people become ethically disengaged and more narcissistic and complicit in a growing culture of cruelty and criminalization. As proof, Giroux points to several examples, including the overrepresentation of underprivileged youth in the criminal justice system and public schools’ adoption of “zero tolerance” policies – rules that disproportionately affect minority students, according to Giroux.

He also notes the denigration of the language of public engagement and civic responsibility. One example from recent headlines uses the phrase “hug-a-thug programs” to describe youth outreach initiatives in urban, low-income neighbourhoods. He notes that one of the major problems facing societies that lack a language for the common good is that they have no way of translating private problems into public considerations. Hence, there is a tendency to privatize all problems and a failure to understand the broader economic, social and political contexts that produce them.

Of course, the situation doesn’t have to be this way, Giroux stresses. But to change the status quo, and by extension protect the ideals of democracy, he believes society must support those public spheres such as higher education where students and adults can learn the knowledge, critical skills, values, and social relations necessary to thrive in a democracy. And Giroux is doing just that – all with the aim of creating a well-informed populace willing to struggle for and sustain a society rooted in the principles of equality, freedom, and justice.

“We each have a responsibility to address social injustices. There is an urgency to make the planet a better place to be. But we need to wake up, and defend our public institutions and values.”

For Giroux, this project involves a myriad of transformations. Among them is seeing educational institutions as places where meaningful and engaged
Few people appreciate the richness and precision of sound more than lovers of classical music. So, when a music-afficionado and musician, even an amateur one, loses his ability to clearly distinguish timbre and harmonics, he has lost a vital part of his world.

Henry Becker knows about that loss. The 83-year-old former chemical engineering professor has suffered hearing deterioration as he aged – aggravated by a flight more than a decade ago in an unpressurized plane in Costa Rica. Gone was the joy of hearing clearly the harmonics of violin strings streaming from speakers that once belonged, he says, to pianist Glenn Gould. Perhaps worse, he couldn’t play his own violin with assurance.

“I quickly noticed there was something missing from my speakers (after the trip) when I played my music. It seemed the high frequencies weren’t coming through quite properly. It made me quite unhappy because music is quite a part of my life.”

Now, after undergoing field trials – and dealing with audiologists and ear, nose, and throat specialists – VitaSound is selling its hearing-aids, among other things, using retail channels at the Walgreens pharmacy chain in the U.S. and in Walmart stores in Canada. By the end of next year, said president Gora Ganguli, the company hopes to have 450 locations south of the border and 75 in Canada.

“Without overstating it, the evidence we have today clearly demonstrates this is the best hearing technology in the market,” said Ganguli, also chief executive of the private company.

“We’re actually very happy this is a Canadian story, right from research to commercialization.”

The research story at McMaster goes back at least a decade as Sue Becker worked with colleagues Laurel Trainor, Ron Racine and John Platt in the Psychology department, as well as Simon Haykin and Ian Bruce, in Electrical and Computer Engineering. They formed the Intelligent Hearing Aid group. The group was interested in hearing loss, in brain plasticity, and in the brain’s ability to relearn how to hear in cases of impairment, such as is caused by nerve damage or damage to receptor-transmitter hair cells in the inner and outer ear.

“We were kind of brainstorming something we could all work on together,” says Becker, “something we
hoped would have a benefit (for society). We just all saw it (coming out with a new hearing-aid technology) as an area where there was huge room for improvement.”

Hearing-aid technology is complex. Such terms as speech-enhancement algorithms and digital loudness control are stock-in-trade phrases. One predominant technology is wide dynamic range compression (WDRC), wherein the hearing aid provides different degrees of amplification, depending upon the loudness of the sound.

The McMaster group thought they had a better idea. Their Neuro-compensator technology starts with a computerized model of the human ear structure. In effect, it tries to predict how a normal ear responds to sounds and also models the responses of a hearing-impaired person. The Neuro-compensator model decides how to adjust the volume for a sound as a whole to get optimal restoration of ear function.

It amplifies the audio bands to try to reproduce near-normal neuronal activity in the brain and ear auditory system, even with damage to the ear. The idea is that the output from the Neuro-compensator’s software-on-a-chip methodology provides signals similar in strength and quality as those in a person without hearing loss.

About five or six years ago, Becker joined forces with former Gennum Corp. employee and now VitaSound chief technology officer Philippe Pango and benefited from an Ontario Centres of Excellence “Market Readiness” grant to take the technology further. Eventually, the research led to the Neuro-compensator device now being sold by VitaSound Audio.

The hearing-aid market is huge. A 2011 report by iData Research, a large medical-device market research firm, valued the hearing-aid and audiology device world at more than $5.7 billion US in the United States alone. That market size was expected to reach $8 billion in another six years, said the report from Vancouver-based iData.

To further augment its research data, McMaster is beginning to do head-to-head – perhaps that’s ear-to-ear – comparisons with other leading-edge hearing aid technologies. The study will look at such things as speech understanding, sound localization, and music perception.

“It would be tremendously gratifying to be able to see the fruits of all this work... all this collaboration at McMaster,” says Becker. “It would be very satisfying to feel like we would have had an impact on something so important.”

VitaSound Audio Inc., located at McMaster Innovation Park, employs more than 60 people in Canada with products sold across North America. VitaSound’s hardware and software technologies improve the performance of hearing-aids and other hearing devices. Their Neuro-Compensator technology, developed by Sue Becker, Simon Haykin and their McMaster colleagues, has helped VitaSound change the industry, when their product became commercially available in 2009. The technology is being adapted to work in consumer electronics like MP3 players, mobile phones and televisions.

In June, 2012, VitaSound president Gora Ganguli, was awarded McMaster’s Vice-President Research Industry Partner Award, designed to recognize successful partnerships with industry. Specifically, the award recognizes businesses who have made a significant contribution to developing the University’s research mandate, and is judged on the impact and benefit of the invention/technology, the strength of intellectual property tied (including patents, copyrights and trademarks), and external recognition.

“In October, 2012, McMaster and VitaSound Audio were awarded the prestigious Mind to Market Award from the Ontario Centres of Excellence (OCE). The Award honours and celebrates the best OCE-supported research collaborations between the business and research communities resulting in commercialization of leading-edge ideas and solutions. In presenting the award, Ontario’s Minister for Economic Development and Innovation Brad Duguid said, “VitaSound’s unique technology is not only a testament to the incredible research and development being undertaken in Ontario, it is also improving the lives of Ontarians.”

“Without overstating it, the evidence we have today clearly demonstrates this is the best hearing technology in the market.”

– Gora Ganguli, CEO VitaSound Audio
Imagine walking down any crowded street in Ontario, knowing that one out of every three people you meet will die before the week is out. That was the reality of the Black Death when it descended on Europe in 1347 – a virulent plague that cut a swath through 40%-50% of Europe’s population.

In one of two burial pits used to cope with the massive numbers of bodies, McMaster evolutionary geneticist Hendrik Poinar and his international research team discovered the genetic key to the pandemic that altered the course of history.

Using their own unique methods of extraction and purification, the researchers teased out DNA from the teeth of five plague victims, decoded the fragments and reconstructed the genome of the Black Death – some 4.5 billion genetic ‘letters’ that provide the hereditary blueprint of the deadly pathogen.

“What we discovered is that this bacterial strain of Yersinia pestis is the ancestor of current human circulating strains today,” explains Poinar, “Every outbreak across the globe stems from a descendant of the Black Death.”

Poinar’s discovery provides the tools to better understand how and why the Black Death pandemic happened and, specifically, why it was so virulent compared to outbreaks today – tools that can be used to fight the plague outbreaks that still occur, and ultimately leads to a new era of infectious disease research. Tackling yet another pandemic – the Human Immunodeficiency Virus (HIV) – Poinar is developing extraction and evaluation methods that will disentangle the origins, evolution and migration of HIV from what has been regarded as the largest collection of the earliest HIV-1 cases from Africa to the New World.

The next challenge: to explore beyond the flesh, blood and bones of our ancestors, to answer questions about animal and plant populations before and after humans made their impact. Using DNA extracted from the Arctic permafrost, Poinar will map out bacterial, plant and animal communities over the last 150,000 years in an effort to understand how climate change in the past affected plant and animal species. The final result: a predictive model that will monitor the impending change in a future warming Arctic.

Whether it’s an ancient plague, the current AIDS epidemic or evolutionary changes during times of climactic instability, Hendrik Poinar provides the science that fills in those ‘gaps’ from our genetic past, which leads to a better understanding of our present, and offers solutions to the problems in our future.
John Brennan – Canada Research Chair in Bioanalytical Chemistry and Biointerfaces

With a simple lab-on-paper detector strip, a McMaster University-led consortium could soon offer a watershed innovation to keep swimmers and children playing just off the beach safe from a debilitating, sometimes even fatal, infection. The bio-detector can be produced cheaply and detects water-borne E. coli (Escherichia coli) or coliforms in 30 minutes. That quick turnaround time is important for waterfront areas that lack ready access to a laboratory. Even if there is a lab handy, testing in such a facility may take up to three days.

Having water safe enough to swim in is a constant threat during summer. For example, eight beaches in the Hamilton watershed area were closed – often due to bird fecal droppings in the water – for a total of 94 days between late May and early September last year.

While this portable strip relates to swimming water, the Sentinel Bioactive Paper Network – a multimillion dollar collaboration involving industry, government and academic partners – is also working on more exacting technology to detect pathogens in drinking water.

Similar to other applications created by the Sentinel group, the technology uses an inkjet printer to lay down colorimetric reagents onto the paper, along with other agents that intensify the colour. When the bacteria are present, the enzymes within the bacteria convert the yellow reagent to a purple product.

“The intensity of the colour will tell you how much E. coli you have,” said John Brennan, Canada Research Chair in Bioanalytical Chemistry and Biointerfaces. “...The test strip is very low-cost, very easy to use and very sensitive.”

For now, the detector kits are designed for use in swimming water. The standards for safe drinking water are hundreds of times tighter than those for safe swimming water. Typically, limits for safe swimming allow for up to 500 cells in 100 ml of water. For water to be deemed safe for drinking, there cannot be even one cell in 100 ml – about a half-cup of water.

The acute dangers posed by waterborne E. coli were well illustrated in a devastating outbreak in the Lake Huron-area town of Walkerton in May 2000. More than 2,000 people became seriously ill and seven died from exposure to microbially-contaminated drinking water. Two pathogens were identified as being responsible, including Escherichia coli 0157:H7.

The strips utilize two enzymes that are bio-markers of E. coli (beta-galactosidase) and fecal coliforms (beta-glucoronidase). Including more exacting steps, such as using immunomagnetic nanoparticles for selective preconcentration, would ramp up the paper strip’s efficacy.

And, a submission in the Analytical and Bioanalytical Chemistry journal notes that “inclusion of a culturing step allows detection of less than 1 cfu (bacterial colony forming unit) in 100 ml within 8 hours, making the paper tests strips relevant for detection of multiple pathogens and total coliform bacteria in beverage and food samples by workers during a single shift.”

One organization keen on a portable bio-detector strip is The Water Chronicles, a media and research organization that works with local health units, municipalities, provincial and federal governments, and others to collect data on unsafe water spots. Among other things, their site tracks boil-water advisories across Canada.

“I think it would be a good solution for a lot of First Nations Reservations in Canada,” said Bob Brouse, senior correspondent at the Ottawa-based agency. “...We had more than 1,700 boil-water advisories in cities and towns and reservations within a month or so. I think, if mom and dad could pull out a sample strip and put it in the water, then they’ve got a good idea of whether the kids are going to get sick or not.”

Brennan said that an Idea to Innovation grant from the Natural Sciences and Engineering Research Council (NSERC) will allow the Sentinel consortium “to look at methods to scale this up to producing tens of thousands of strips a day and undertake external validation studies, which are an important first step in obtaining regulatory approval. We expect, maybe in two to three years, we should have the first product ready to launch.”
As a scientist, John Valliant instinctively understood the need for a centre with a program that would bridge the chasm between innovative discoveries in the laboratory and the development of tools for the detection and treatment of disease for critically ill patients.

“In Hamilton, there are great physicians and outstanding basic scientists. (The challenge) is connecting these groups to help patients by developing better diagnostic tools,” said Valliant, scientific director and CEO of the Centre for Probe Development and Commercialization (CPDC), and associate professor in the Department of Chemistry and Chemical Biology.

Valliant knew development of these valuable connections was hindered by long-standing regulatory hurdles and lack of funding. His opportunity to surmount them, and move laboratory discoveries rapidly into patient care, arrived in 2008 when the federal government launched the Centres of Excellence for Commercialization and Research (CECR) program and the Ontario government made an investment in translational cancer imaging research through the Ontario Institute for Cancer Research (OICR).

Out of these initiatives, the CPDC emerged, supported by $22 million in funding from the CECR program, OICR, Cancer Care Ontario and one of CPDC’s key industry partners, GE Healthcare. McMaster University is the centre’s host institution. Today, the CPDC is a world leader in the development and commercialization of molecular imaging probes, which are made using medical isotopes. These advanced new medical tools are expected to improve diagnosis of serious illnesses like cancer, Alzheimer’s disease, Parkinson’s disease and heart disease. They can also play a role in monitoring the treatment of patients and help increase the speed, efficiency, and cost effectiveness of drug development for cancer and other diseases.

A probe is like a drug that is injected into a patient. Its job is to seek out the disease and send a signal that is used by a positron emission tomography (PET) camera to create a detailed 3-D image of the diseased tissue. PET images enable doctors to see the biochemical activity of a disease, a method that is more sensitive and specific than conventional imaging methods like X-rays, which can only show structure. Imaging probes have the potential to provide information far earlier than can be done using existing technologies; enabling physicians to evaluate the aggressiveness of a cancer, the likelihood of a patient to respond to a particular treatment and the effectiveness of a treatment.
In a panel discussion with Canadian leaders in molecular imaging, organized by the Canadian Institutes of Health Research (CIHR), Valliant outlined his centre’s work in developing the next generation of molecular imaging probes and the important role this technology will play in future healthcare.

“Our group works on all facets of the field, from basic science to production for clinical use and clinical research. If you look to the future of medical isotopes and the associated imaging tools, I believe you’re going to see more specific tools that help physicians stratify patients and select therapies. You’re going to see more imaging tools being used to guide biopsies, to help with pathology assessment and surgical guidance.

“So, you’re going to find that the imaging and probe development fields will not be standalone entities used solely for early diagnosis; they’re going to be linked to pathologists and surgeons who routinely will use imaging technologies. An example is groups that are working towards one-stop breast cancer screening programs that include both imaging, biopsy and tissue analysis, which is going to require coordination between radiologists, nuclear medicine specialists and the people who do the pathology on tissue samples. It will also require the creation of new probes.”

Valliant calls molecular imaging “truly revolutionary” with benefits to both the patient and to the healthcare system. Imaging probes can be used to select the right therapy for each patient by understanding the specific biochemical features of their disease.

As a not-for-profit, stand-alone, Hamilton-based centre, the CPDC’s mandate is to drive the translation and commercialization of newly discovered imaging probes. It has introduced three new molecular imaging probes to Ontario that are involved in 10 clinical trials whose main focus is cancer with studies on other conditions, such as Alzheimer’s disease, Parkinson’s disease and Multiple Sclerosis, scheduled to start in the near future.

A key component of the centre is its clinical collaborations including those in Hamilton that links nuclear medicine and oncology. Hamilton is home to world-class programs in oncology and nuclear medicine, said Valliant. “The ability to combine a probe development initiative with world-class nuclear medicine and clinical trials programs is a unique opportunity that will make things happen for cancer patients in Hamilton.”

The centre is also branching out beyond Hamilton: It supplies imaging agents to multiple centres in Ontario and has developed a collaboration, called CanProbe, with the University Health Network in Toronto to advance the use of medical isotopes and develop and translate new probes. “Rather than having competition between the two cities, we are working together to leverage the strengths of our collective programs which I think is fantastic,” Valliant said. “And now we are branching out and doing this nationally, working with sites across Canada.”

Through its manufacturing program, the centre is now one of the leading suppliers in Ontario of the radiopharmaceutical fludeoxyglucose (FDG), which is used for cancer imaging studies and marketed as Glucovision®. Every day, usually at about 4 a.m., the centre starts manufacturing Glucovision along with several investigational agents for clinical trials. The probes are shipped to major hospitals in Ontario and as far away as Thunder Bay.

“The ability to combine a probe development initiative with world-class nuclear medicine and clinical trials programs is a unique opportunity that will make things happen for cancer patients in Hamilton.”

Now in its fifth year, thousands of patients have been scanned using CPDC-produced probes. “I believe the CPDC has demonstrated that our model for fostering translational research and commercialization works and that such achievements rely on connecting people who do the world-class basic research with people who do clinical work with industry. This approach will create new markets, foster economic growth and ensure Canadian patients have access to the innovative and effective imaging technologies of tomorrow today,” he said.
A needle to the eye is an experience that most people care to avoid. But for those with vision-related diseases, there is often no choice in the matter. Every six to eight weeks, they must endure painful injections of therapeutic drugs directly into their eyes. Fortunately, researcher Heather Sheardown is exploring other ways to administer that medication, and along the way, is working to prevent vision loss and blindness altogether.

A professor in McMaster’s Department of Chemical Engineering and School of Biomedical Engineering, Sheardown is cross-appointed to the School of Optometry at the University of Waterloo. She is also founder and scientific director of the 20/20 Natural Sciences and Engineering Research Council of Canada Ophthalmic Materials Network. A consortium of industry partners and Canadian researchers (including several from across McMaster), 20/20 is developing and commercializing new biomaterials and devices to treat vision disorders.

“Our ultimate goal is to stop disease. It is my hope that we can maintain vision and even improve it,” says Sheardown.

According to the CNIB, more than one million Canadians are living with blindness or a significant loss of vision. Among the major causes of vision loss are two conditions that involve the back of the eye – age-related macular degeneration and diabetic retinopathy. Therefore, as the population ages and diabetes becomes more prevalent, the number of Canadians with vision loss could double within the next 25 years.

Impaired vision has various consequences. In addition to costing the Canadian economy more than $15 billion annually, blindness and vision loss have a dramatic effect on quality of life. For example, compared to people who are sighted, those with vision loss are more likely to experience falls, injuries and clinical depression, and on average are admitted to nursing homes three years earlier.

Sheardown’s visionary research focuses on two regions of the eye: the front and back. With regards to the former, she is experimenting with naturally occurring materials, such as collagen, to develop artificial corneas. One day, these biomaterials could restore sight to people with cornea blindness, which affects millions of people worldwide.

In the meantime, Sheardown admits there are many challenges to overcome. For instance, artificially created corneas must be transparent and integrate well into existing tissues. Equally important, manufactured corneas must remain in position, resisting the body’s automatic reaction to push them out.

When it comes to treating the back of the eye, however, Sheardown faces a different challenge: nature itself. “The internal structures of the eye are designed to keep things out, so it’s challenging to access the back of the eye,” says Sheardown.

On that note, she is developing biomaterials that will eliminate the need for invasive treatments, such as syringes, and instead deliver medication to the back of the eye in a pain-free manner. One example: a flexible, rubbery patch that conforms to the eye’s contour and can be worn behind the lens for up to a year. Using micro-needles that are too small to feel and can be tailored to reach different layers of the eye, the device will slowly release controlled doses of medicine. Furthermore, the patch can be attached during an in-patient procedure and will not affect the patient’s eyesight when in use.

Sheardown’s device could bring tremendous relief and hope to patients, says John Clement. A partner in AmorChem Financial Inc., a Montreal-based venture capital firm, Clement serves on 20/20’s board of directors and was once a director at iCo Therapeutics, one of the network’s industrial partners. He believes Sheardown’s innovative work in the laboratory is a symbol of her forward-thinking approach to ophthalmic research, in general.

“At the 20/20 network, she has brought together unanticipated partners. Chemical engineers, for example, are working on biological problems, and that allows ideas to be cross-fertilized. It also brings new perspectives.”
Cat allergy sufferers can look forward to much longed-for relief with a new treatment under development by researchers at McMaster University.

Immunologist Mark Larché, professor in the Department of Medicine in the Michael G. DeGroote School of Medicine, is leading a research program on “peptide immunotherapy.” The results from clinical trials show a significant reduction in the annoying symptoms which people with an allergy to cats commonly face. An estimated 15-25 per cent of people worldwide suffer from an allergy to cats.

To develop the treatment, researchers took one protein, Fel d 1, a protein responsible for most cat allergies that is secreted onto the skin and transferred to fur through grooming. With blood samples from 100 patient volunteers allergic to cats, they deconstructed the molecule and identified short regions (peptides) within the protein which activate T-cells in the immune system. “We believe it is the T-cells that are driving the allergic response,” said Larché, who holds the Canada Research Chair in Allergy & Immune Tolerance.

Using the amino acid code for the whole protein, researchers made synthetic versions of these regions. They mixed seven peptides to produce the immunotherapy. “We picked the peptides that would work in as much of the population as possible,” Larché said.

It is a molecular approach in which the synthetic peptides, each only 13-17 amino acids long and derived from Fel d 1, quiet the immune system’s aberrant T-cell response and avoid activating mast cells, which cause allergic reactions and anaphylaxis.

Patients receive four low-dose shots injected into the skin at one month intervals. The treatment is proving to be effective and safe without the side effects of traditional treatments, such as antihistamines, decongestants and allergy shots. Participants in a phase 2 study showed a significantly greater reduction in sneezing, nasal congestion and itchy, watery eyes than those receiving a placebo.

Earlier this year, Larché received a $6.4 million grant from the National Institute of Allergy and Infectious Diseases, part of the United States National Institutes of Health (NIH), to support a five year study into this treatment. The study will also investigate precisely how the white blood cells that are targeted by the immunotherapy contribute to asthma.

The clinical development of the cat allergy immunotherapy is being undertaken by Adiga Life Sciences, a joint business venture between McMaster University and Circassia Ltd., a UK-based biotech company.

In early October, Circassia announced the launch of a phase 3 study of the therapy in approximately 94 centres across the United States, Canada and Europe. The company expects to complete the trial by mid-2014.

The partners are collaborating on research into the use of peptide immunotherapy for house dust mite, ragweed, grass, birch tree and moulds. They are also working to define a similar therapy for rheumatoid arthritis and investigating the possibility of research into scleroderma, a chronic autoimmune disease, funded by the Scleroderma Society of Ontario.

The work builds on research Larché conducted in Canada and Britain over the last 18 years.
Canada’s vital manufacturing sector has been under siege for some time.

Hit hard by a perfect storm of factors – intense global competition, the recession, a rising Canadian dollar, and higher energy costs – manufacturing jobs and output have declined.

As the sector fights hard to compete internationally, companies have implemented Lean Thinking: improve productivity, trim waste, and make processes as efficient as possible. They want to build on the nearly 15 per cent of total economic output occupied by manufacturing.

Stephen Veldhuis, director of the McMaster Manufacturing Research Institute (MMRI), offers a cutting edge to help factories work smarter, reduce costs, and stay competitive on the global market.

In collaboration with various industry partners, researchers in the 11-year-old institute focus on improving the performance of computer-controlled industrial machines that sculpt metal parts in cars or planes or other equipment. The actual cutting-tool materials that do the work in these large machines might cost anywhere from $10 to $300, but this is only about 5 per cent of a factory’s operating budget. The role tooling plays in manufacturing processes, however, is out of proportion to its size and cost.

Put an inadequate cutting tool into a multi-million dollar machine and you don’t achieve the desired geometries in a machined part. A short-lived tool can shut down an entire line, stopping production and idling machines and workers.

The National Research Council estimates the loss in gross domestic product due to machine and equipment-line wear at 1 to 2 per cent a year. With GDP at $1.7 trillion last year, even a tiny hit would be huge.

“The point is, if you watch your pennies (tools), the dollars (productivity) figure themselves out,” says Veldhuis. “…Having a more advanced tool allows you to realize new products, higher performance. It allows you to work more efficiently, more competitively.”

MMRI research has led to tool-life improvements of up to four times, said Veldhuis.

As he notes in a nation-wide automotive program, AUTO21: “In many applications, it is the performance of the surface of a tool that limits the performance of the manufacturing process.” (MMRI plays a key role in AUTO21 as the auto industry works with scientists to innovate tomorrow’s technologies.)

MMRI labs seek technologies that lead to more lubricious tool coatings to reduce friction. Researchers work towards more durable and longer-lasting cutting surfaces; they push tool capability to work on super-hard oxidation and corrosion-resistant alloys that operate at very high temperatures, such as in a jet engine.

This research has big environmental payoffs. Improved coatings mean less use of liquid lubricants and coolants. This leads to lower production costs and, combined with performance gains, makes for a greener factory.

This search for better tools gets down to incredibly small levels. For example, AUTO21 work includes development of nano-crystalline wear-resistant coatings, such as titanium aluminum nitride based materials. (A nanometre is a unit of length equal to one-billionth of a metre.)

Scientists at the MMRI and the Brockhouse Institute for Materials Research (BIMR) together assess critical surface features of tool wear and coatings. The goal is to avoid lost production and quality issues.

Cumulatively, the impact is reduced production costs associated with tool changes and online monitoring – key factors for Canadian manufacturers who seek a sustainable competitive advantage over regions that benefit from low-cost labour.

MMRI will soon become involved with new automotive technologies through the university’s MacAUTO initiative. MacAUTO is co-ordinating research into auto design, power-trains, lightweight materials, and other vehicle technologies. It will soon work out of an auto resource centre at McMaster Innovation Park (MIP).

“If new motor designs are innovated, those new pieces and designs have to be produced and that often involves machining . . . So we’ll be working closely with (MacAUTO director) Ali Emadi’s people at MIP, converting their innovations into opportunities for Canadian manufacturing companies.” said Veldhuis.

Countries around the world are studying high-performance tooling. In Canada, McMaster is part of the Natural Science and Engineering Research Council’s CANRIMT, a national research network looking into machining-system simulations and innovative strategies to collect this research in a way that companies can readily use.

For Canada to optimize the value of its manufacturing research, innovations leading to new products must be aligned with Canadian companies to retain economic activity and employment together with the improved performance and efficiency brought by these changes.
learning happens, not just where profits are made; supporting the development of young people, not spending more money to police them; and waging a war on poverty, not the poverty-stricken. It also entails dismantling those economic institutions that disdain public life, emphasize individual advantage over the public good, and recklessly use their power in the interests of financial gain to the detriment of the larger society.

Furthermore, Giroux thinks society must make a fundamental shift in the cultural realm – away from a popular culture fixated on commercially carpet bombing young children, celebrating an empty and trivial celebrity culture, and reproducing a ruthless survival-of-the-fittest ethic through an ever expanding glut of Realty TV. This is more than a call for more thoughtful content; it is a call to rethink the very nature of our society and the culture that drives it. To that end, he is making critical analyses and alternative theoretical frameworks more readily available as a regular contributor to Truthout.org, an independent news and commentary website, and through the various book series that he edits (with his wife, Susan Searls Giroux) at Palgrave Macmillan and Paradigm Publishers.

Additionally, Giroux has spearheaded the creation of a new research centre on campus. The Centre for Scholarship in the Public Interest brings together scholars to conduct interdisciplinary research on several complex subjects, including youth resistance movements, global inequalities, the impact of digital technologies and social networks, and the future of higher education institutions.

Ultimately, Giroux hopes his work will help people to realize that seemingly disparate problems in society are indeed linked. And he would like to see new social movements emerge to tackle those challenges.

“At the moment, too many people are comfortable with the current state of the world,” he says. “But to move forward, people will have to imagine the unimaginable and learn how to govern rather than merely be governed.”

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James Dunn
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