

BioLAB BUSINESS

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Emily Choy, the first female Explorer-in-Residence for the Royal Canadian Geographical Society

LAB PROFILE

Winterlight Labs uses AI to analyze speech and identify cognitive disorders

CELEBRATING BIPOC & WOMEN IN STEM



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across Canada

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Emily Choy is the first female Explorer-in-Residence for the Royal Canadian Geographical Society

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BioLAB BUSINESS



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Publisher of *BioLab Business* Magazine

WEAVING EQUITY, DIVERSITY AND INCLUSION INTO THE FABRIC OF CANADIAN RESEARCH

■ BY CHRISTOPHER J. FORBES

As publisher of *BioLab Business*, I typically leave the editorial aspects to my brilliant team, and do what I do best, which is to promote the magazine to leaders in Canada's STEM ecosystem.

But with the induction of the country's first Inuk governor general, I felt strongly that for this fall publication I needed to put pen to paper – or more correctly, fingertip to keyboard. The issue showcases and celebrates equity, diversity and inclusion in science. When Mary Simon took her official oath in the Senate Chambers this past July, it triggered a sense of optimism, particularly for researchers from Indigenous communities and visible minorities. The event was more than an inauguration. It symbolized a celebration of diverse viewpoints and the potential to elevate the dialogue of inclusion, a ray of hope amid the clouds of bigotry and racism that have darkened Canada's landscape.

In her inaugural speech, Her Excellency commented, "To meet this moment as governor general, I will strive to hold together the tension of the past with the promise of the future, in a wise and thoughtful way." As a research community, we have to accept that it is indeed "wise and thoughtful" for us to embrace equity, diversity and inclusion (EDI).

For far too long, minorities have been underrepresented in science and science education, and we've missed out.

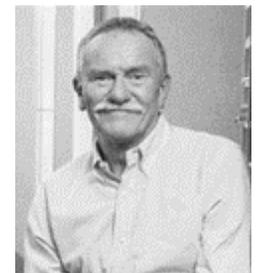
Weaving the tenets of EDI into the fabric of Canadians' scientific discovery holds value beyond social justice. It widens the nation's pool of scientists and invigorates discovery through unique cultural practices and perspectives that lead to sound scientific questions, problem solving and growth.

And, while the Canadian government has taken steps in the right direction with investments and pilot programs like the Dimensions EDI awards and the New Frontiers in Research Fund, more needs to be done to remove obstacles faced by women, Indigenous Peoples, persons with disabilities, members of visible minorities, racialized groups and members of LGBTQ2+ communities.

For one thing, we're missing critical information if we are to improve and drive deeper change. The data on STEM projects under the leadership of these groups is not consistent, and information on university graduates from underrepresented populations is sparse. So how can you improve it, if you can't measure it?

For meaningful transformation, we need more support – financial and otherwise – for organizations and individuals like those featured in this issue: leaders like the Canadian Black Scientists Network and the Queer Atlantic Canadian STEM group, Arctic trail blazers like Emily Choy, the Peace-Athabasca Delta Institute where western and Indigenous researchers work collaboratively, and Toronto's Winterlight Labs (featured on p.27), where a majority of women engineers, machine learning experts and scientists use advanced technology in speech recognition to build our understanding of dementia.

There is no doubt in my mind that equity, diversity and inclusion make for better science. Let's be "wise and thoughtful" about how we weave it into the Canadian research landscape.



Christopher J. Forbes
PUBLISHER & CEO



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We are an organization that serves our membership by providing services that can grow your business.

- Quarterly Macro/Micro reports providing detailed information of the Canadian environment business.
- Salary Surveys that are specific to our industry and data that is 100% Canadian.
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The Canadian Laboratory Suppliers Association is a group of scientific companies committed to promoting and serving the Canadian laboratory marketplace.

The CLSA provides a non-competitive environment for executives of Canada's leading scientific suppliers to share ideas and concepts.

The objective of the CLSA is to provide market analysis on the scientific industry, and to understand and discuss issues that influence the Canadian laboratory scientific market. These issues include: how government policies affect the scientific industry, how and why the industry is changing in Canada (changing economic climate) and market trends.

DIVERSE RESEARCH LABS ARE THE ANSWER

TO BIO-ECONOMY'S TALENT SUPPLY QUESTION

■ BY ROB HENDERSON

For years, many professionals have focused their attention on finding ways to ignite the brainpower of Canada's bio-economy. The reason is simple: Great ideas are just ideas without great people to execute them. The reality is that the entire industry is running out of runway and needs to learn to fly or it will fall off the cliff.

For Canada's bio-economy to meet forecasted talent supply benchmarks by 2029, industry must aggressively expand its recruitment and retention efforts to include underrepresented, readily available talent. That group includes women, Indigenous, Canadians with disabilities, LGBTQ2S+, newcomers and members of visible minorities. Not only that, the numbers indicate we will also have to look for non-traditional job seekers from other industries as well.

This isn't a prediction, it's a spoiler. BioTalent Canada has been spearheading an in-depth national Labour Market Information Study (LMI) since 2018. The full report will be released this fall, but there is a number we need to focus on now: 5,160. That's the number of additional workers that just the bio-manufacturing sector, in its current state, will need by the end of the decade. The number for the entire bio-economy is far greater and will be released in the full report.

Talent supply isn't a new issue. We examined the topic in depth in our 2015 Labour Market Report "Moving Beyond the Boundaries: Women in Biotechnology" and 2017 Labour Market Report "Paving the Way: IEP."

The numbers are concerning. If industry fails to diversify, talent demand will outweigh supply, progress will slow, and economic growth will stall.

Research labs across Canada are pivotal to industry growth, and diversity in those labs is vital to long-term industry

success and sustainability. The need for a more inclusive environment in labs isn't about putting warm bodies in research labs to reach a number. It's about casting lines into a deep talent pool that, until now, has been underfished.

A 2017 Boston Consulting Group study concluded that diverse teams, on average, produce 19 percent more revenue than teams who lack diversity. These companies discovered they develop products more in tune with consumer needs. Why? Because diverse workforces generate diverse perspectives that consider the pain points specific to more segments of the population.

Anecdotally, since COVID-19, BioTalent Canada has grown in numbers, and our own workforce has grown more diverse than ever. That diversity has been the propellant for our own growth.

Today, women account for less than 40 percent of the bio-economy workforce. This underscores a lack of opportunity more than a lack of interest in the industry. Most students in STEM and health-related undergraduate and master's programs are female. This lack of representation in the workforce is a problem which must be remedied if the industry is to remain competitive.

Increasing the number of work-integrated learning (WIL) opportunities could help close this gap, and we're starting to see that happen. In pre-COVID times, women made up 56 percent of participants in BioTalent Canada's Student Work Placement Program. So, women are seizing opportunities to get a foot in the door – and full marks to the federal government for adding financial incentives for employers to offer additional WIL enhancements to women and other underrepresented groups.

The internationally educated professional (IEP) is another overlooked pipeline for talent. Canada welcomes some 300,000 newcomers every year, many with STEM experience. But many employers shy away from hiring them because IEPs are perceived to lack the essential skills to perform in a Canadian research environment.

BioTalent Canada now offers an essential skills training program that we know alleviates some of the concerns an employer might have. IEC-BC, a British Columbia-based immigrant servicing agency, says that essential skills training is a crucial piece in some of their clients getting hired by bio-economy employers.

The talent is out there and ready to contribute. Employers need to leave no stone unturned in talent searches. Underrepresented groups can have a lasting impact on the future of Canada's bio-economy. But without dedicated human resources to create and execute recruitment plans, it's an uphill battle.

Of the companies surveyed for the LMI report, the vast majority lacked dedicated HR expertise. Our research indicates more than 75 percent of bioscience companies only recruit through their own network of personal and professional contacts. "Poaching Peter only to lose Paul" is not an ideal way to increase capacity or create an inclusive workforce. We need to cast a much wider net.

We don't mean to sound reactionary, but the evidence is sounding the alarm. There are myriad opportunities to diversify research departments. If government, business, and academia walk in lockstep, we can create an innovative, cohesive, and inclusive workforce. Canada's bio-economy must up its recruitment and diversity game or be forced to watch from the sidelines.



Rob Henderson
PRESIDENT AND CEO,
BIOTALENT CANADA

BY DAVID SUZUKI



INDIGENOUS KNOWLEDGE

ADDS AN IMPORTANT DIMENSION TO UNDERSTANDING OUR WORLD

“In many ways, Indigenous knowledge is more encompassing and profound than science.”

I was once at the cutting edge of genetics research. The textbook I co-authored was the most widely used in the world. But we ended up writing numerous editions to keep up with evolving knowledge. Newer versions had to account for information that had become irrelevant, or correct for ideas that were later disproven.

That’s not to denigrate our research or any other. It’s how science progresses. We try to make sense of what we observe by setting up a hypothesis, then testing it with experiments and further observation. Then we modify or throw out the hypothesis, depending on the findings or in response to subsequent research.

Like much of everything, science can be influenced by money and profit. So, there’s often a rush to patent every new insight to get something to market even if its application might turn out to be ineffective or harmful. Think of thalidomide, a drug used to help pregnant women sleep better. It resulted in babies born with severe limb malformations.

Geneticists in the early 20th century extrapolated from studies of heredity in insects and plants to human intelligence and behaviour. Their claims were used to justify laws that discriminated against immigrants from nations believed to be inferior, sterilization of people in psychiatric institutions, incarceration of Japanese people born and raised in North America, and the slaughter of Roma, Jews and homosexuals in Nazi Germany. Some scientists continue to claim that criminality, differences in intelligence, alcoholism, etc. are inherited.

When scientists focus on a fragment of nature, they gain powerful insights into a bit of how the world works. We discover all kinds of things because

we often start from a place of relative ignorance. The late Cornell University professor Thomas Eisner, a leading insect expert, told me he could discover a new insect species in New York City’s Central Park any day — in one of the biggest cities in the world. Think of how little we know about life in the Amazon rainforest, the Great Bear Rainforest or the oceans.

Science is great at description. But every discovery needs to be put in a perspective that acknowledges our ignorance. Not long ago, marine biologists assumed microscopic phytoplankton were the base of the marine food chain. In the mid-1980s, they found cells 10 times smaller than phytoplankton called “picoplankton” that went through the mesh in their nets. Picoplankton are so abundant, they may produce as much oxygen as all phytoplankton. Yet until recently, we didn’t know they existed.

As useful a tool as science is, it often fails to consider the big picture. Paul Mueller won a Nobel Prize in 1948 for developing the insecticide DDT. As its use ramped up, Swiss company Geigy made a lot of money, and DDT knocked the hell out of insects. But over time, birdwatchers began to notice bird populations were declining. Biologists tracked it to DDT accumulating in shell glands, making eggshells thinner and prone to breaking. They had discovered biomagnification, a phenomenon that scientists didn’t know about until DDT was used.

Science is often considered to be objective, but that means it can be used for good, bad or indifferent purposes. We need more observational science, but we have to recognize its fundamental weaknesses and inadequacies, and scientists must be careful not to confuse their biases with truths. Science is a specific way of knowing that must be situated within a broader context to be significant and relevant.

In many ways, Indigenous knowledge is more encompassing and profound than science. It embraces gratitude, love, respect and a deep sense of responsibility. Scientists scrub such emotions in the name of objectivity and try to find universal principles that can be replicated anywhere.

Indigenous knowledge is the accumulated observations, trials and errors, successes and failures of people living in place. It’s critical for a peoples’ survival and has been tested by their presence over thousands of years.

It’s also deeply subjective and meaningful, considering the web of relationships with all other animal and plant species, and air, water, soil and sunlight. The element of reciprocity, of responsibility, is missing in contemporary science, and society in general.

We need both science and Indigenous knowledge for a fuller understanding of our place in the world.

Dr. David Suzuki is a scientist, broadcaster, author and co-founder of the David Suzuki Foundation. Learn more at davidsuzuki.org.

Study shows Canadians want more minority groups in STEM jobs

New research released this summer by 3M shows that 87 percent of Canadians feel it's important to increase diversity and inclusion in STEM jobs and 68 percent acknowledge that underrepresented minority groups often don't receive access to STEM education. The annual State of Science Index, an independent research study commissioned by 3M, tracks and explores global attitudes toward science. Most Canadians (89 percent) believe that science gives hope for the future, and a majority are hopeful that 2021 will be a better year than 2020 because of science.

The survey was conducted earlier this year in 17 countries among 1,000 general population adults. Fifty percent believe more diversity equals greater global collaboration, and almost half feel diversity and inclusion will result in more innovative ideas. Ninety-three percent of Canadians recognize scientists as being critical to our future well-being in light of the pandemic, and 44 percent feel more inspired to pursue a STEM career due to the pandemic.

"Diverse experiences and perspectives working together leads to more effective solutions," explains Penny Wise, president of 3M Canada. "The 3M State of Science Index results underpin the need to unite educators, government, corporations and families, to ensure underrepresented students have equal access to STEM education." Wise believes that Canada needs to support and design an education system that is representative of diverse world views, diverse role models need to be recognized, and actions need to take the conversation about diversity to the next level.

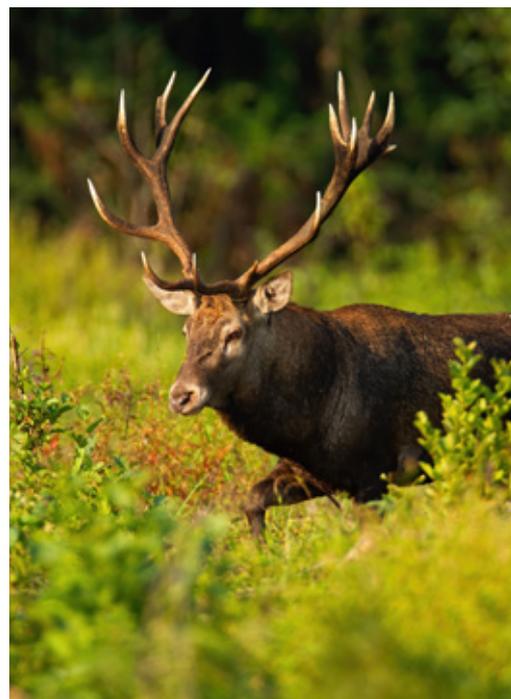
Vanessa Raquel Raponi, a product development engineer and founder of EngiQueers, believes that younger people need to be able to see themselves reflected in the science community and have champions in their life who support those goals. "To do this," she says, "we need to lead youth to show them the path to a career in STEM, that it is possible, that there are opportunities for people just like them and that there are supportive programs, educators and champions along the way who will help lift them to an endless array of possibilities."

TINY INSECTS CAUSE BIG THREAT TO WOODLAND CARIBOU

Threats to Canada's endangered woodland caribou can be traced back to spruce budworm infestations and salvage logging, says a paper co-authored by University of Saskatchewan (USask) researcher Philip McLoughlin.

"Spruce budworms kill the forest, which then leads to a flush of vegetation of benefit to moose. More moose means more wolves, and caribou don't do well when there's a lot of wolves around," noted McLoughlin, an associate professor of biology. These outbreaks recur about every 30 years, and have an effect similar to forest fires and human-caused disruptions like logging, with impacts across the food chain. Outbreaks are expected to increase under climate change.

The NSERC-funded research is the first to show how an insect can play an important role in how species interact. The impact on caribou was magnified by forestry companies establishing roads and trails for salvage logging.





Paolo Mussone at a brownfield site, photo courtesy of NAIT.

Cleaning up contaminated land using tools from nature

Researchers at the Northern Alberta Institute of Technology (NAIT) are developing a renewable product to help clean up tens of thousands of sites contaminated by petroleum products – locations like old gas stations, fuel storage sites and other “brownfields.” Testing for site remediation is expensive, costing tens of thousands of dollars each time, says Dr. Paolo Mussone, Applied Bio/Nanotechnology Industrial Research Chair at NAIT.

In a project that received a \$383,000 investment from Alberta Innovates, the NAIT researchers developed a sampling device that contains a forest-related bioproduct called CNC (cellulose nanocrystals), to monitor how land remediation is progressing over time. They coated a pill-sized white disc with CNC and deployed it in wells at the test sites. The CNC absorbed hydrocarbons and allowed bacteria to attach and degrade contaminants.

Remote electronic sensors were deployed to determine the rate at which hydrocarbon contaminants had biodegraded by monitoring pH levels, soil temperature and other measures. Remote sensors can provide multiple data points at far less cost than traditional monitoring methods. NSERC, industry and NAIT contributed a total of \$780,000 to this project.

The researchers also found an innovative use for lignin, an organic polymer in trees. First, they converted the lignin into a product they called “lignochar” using a special chemical process. Then they added lignochar to contaminated soil. It provided nutrients to naturally occurring soil bacteria that flourished and consumed the hydrocarbon contaminants.

This technology remediates the land and makes it usable through an organic process, without the need to dig out contaminated soils. It’s an environmental and economic win-win, according to Mussone.

“The reason why we have 30,000 contaminated sites in Alberta is because it’s so expensive to remediate them,” he notes. “The value of the real estate tied up in these sites is in the billions of dollars, a significant lost economic opportunity.”

In the quest to find bioindustrial uses for forestry byproducts, Dr. Paolo Mussone also developed a unique application for the oilpatch. He found that fly ash from pulp mills can be used to scrub poisonous hydrogen sulfide from natural gas.

With funding from Ovintiv Inc. and NSERC, the NAIT researchers are exploring how to turn fly ash into pellets to use in separating carbon. Their goal is to validate this concept in the field next year.

The former Kapyong Barracks site in Winnipeg is a 160-acre redevelopment that will create thousands of homes, parkland and commercial space, built on a restored brownfield. It will be the largest urban Indigenous economic zone in Canada.

STUDYING IMPACTS OF AGE ON COVID RECOVERY

Dr. Alyson Kelvin, at the University of Saskatchewan’s (USask) Vaccine and Infectious Disease Organization (VIDO), with collaborators at Dalhousie University, investigated how advanced age impacts the immune responses and protection against SARS-CoV-2, the virus that causes COVID-19. The study involved individuals more than 90 years of age, including some older than 100, who were residents at a long-term care facility in Halifax that experienced a COVID-19 outbreak.

Using VIDO’s containment level 3 facility, it was determined that study participants recovering from COVID-19 had antibodies that were able to neutralize the SARS-CoV-2. This response lasted at least 60 days from the initial infection, suggesting the immune response in older individuals may protect against SARS-CoV-2 reinfection. This is the first study of the immune responses to SARS-CoV-2 infection in people more than 100 years of age. Understanding the immune responses to SARS-CoV-2 in older individuals is of significant public health importance, especially for long-term care facilities.

Researchers create reptile-derived 'super glue'



Western University bioengineer Kibret Mequanint has found a novel use for snake venom: a body tissue "super glue" that can stop life-threatening bleeding in seconds.

The discovery is based on a blood clotting enzyme called reptilase or batroxobin found in the venom of lancehead snakes, among the most poisonous snakes in South America. His team designed a body tissue adhesive that incorporates the special enzyme into a modified gelatin that can be packaged into a small tube for easy, and potentially life-saving, application.

"During trauma, injury and emergency bleeding, this 'super glue' can be applied by simply squeezing the tube and shining a visible light, such as a laser pointer or smartphone flashlight, over it for few seconds," said Mequanint. The new tissue sealant has 10 times the adhesive strength of clinical fibrin glue and resists detachment or washout due to bleeding, with a much shorter blood clotting time.

PHYSICIST WINS AWARD FOR OUTSTANDING RESEARCH

Carleton University's Manuella Vincter, professor in the Department of Physics, has received the Henry Marshall Tory Medal from the Royal Society of Canada. Vincter is the co-recipient of this year's medal along with Ian Manners from the University of Victoria.

As a researcher in experimental particle physics, Vincter is a leader in the Canadian and international physics community. She is the ATLAS deputy spokesperson at CERN, the European organization for nuclear research. A Fellow of the Royal Society of Canada, Vincter also has been honoured with a Canada Research Chair, Killam Research Fellowship and Humboldt Fellowship. Vincter's research contributed to the discovery of the Higgs boson and consolidates the Standard-Model foundations of the Large Hadron Collider's program. Her research program exploring the standard model of particle physics has been critical to the advancement of this field.



SEA LEVEL RISE MAY BE UNSTOPPABLE

New research models the impacts on the Antarctic Ice Sheet of several different global warming scenarios and the resulting effects on global sea levels. The study was led by the University of Massachusetts, Amherst, and included a researcher from McGill University. The scenarios that were considered range from meeting the Paris Agreement target of 2°C warming and an aspirational 1.5°C scenario to our current course which, if not altered, will yield three or more degrees of warming.

If 1.5°C and 2°C Paris Agreement temperature targets are achieved, the Antarctic Ice Sheet would contribute 6 to 11 cm of sea level rise by 2100. But if the current course toward 3°C increase in temperature is maintained, the model points to a major jump in melting that would drastically accelerate the pace of sea-level rise. Changes in Antarctica are anticipated to contribute to about a one metre rise in sea level by 2300 if global warming is limited to 2°C or less, but may reach catastrophic levels without significant, immediate mitigation of greenhouse-gas emissions.

Canada-U.S. renew commitment to the Salish Sea ecosystem

The Canadian and U.S. governments have once again signed a four-year "Action Plan," ratified in 2000, that commits both countries to work together on transboundary issues and challenges facing the Salish Sea ecosystem. Under the action plan, the two nations will continue to engage with partners across the region to advance shared priorities for ecosystem health, including information sharing, improving transboundary coordination, and reporting on ecosystem health. The Salish Sea ecosystem is one of the most biodiverse ecosystems in North America and includes the Juan de Fuca Strait, Puget Sound and Georgia Basin.

Environment and Climate Change Canada and the U.S. Environmental Protection Agency also updated their joint "Health of the Salish Sea Ecosystem Report" analyzing 10 indicators of the waterway's health. Overall trends described in this report reveal some improvement, but also areas of no change or decline that can be identified as ecosystem priorities for future action.



WAX PROVES KEY TO PROTECTING PLANTS AGAINST DROUGHT AND FROST

A team of researchers under Karen Tanino from the University of Saskatchewan, recently used the Canadian Light Source (CLS) to show that cuticular wax – a waxy layer that covers exterior surfaces of plants, much like human skin – provides a barrier against low temperatures and dehydration. Few studies have examined its role in drought and cold temperatures. The ultimate goal of the research is to enable plant breeders to more efficiently select superior genetic lines and develop more climate-resistant crops. The researchers used the Mid-IR beamline at the CLS to study *Arabidopsis* leaves to the depth of two microns, which provided information on the quantity and quality of the surface wax. Plants with less wax froze. Using infrared thermography, the team could visualize heat stress in the plants. The results reinforced that these components in the cuticular layer are crucial for crop resilience.

Lab-produced blood will not only be pathogen and toxin free, it also will have a highly compatible profile, eliminating the issues that regular transfusion recipients experience. “Our end goal is to replace donation with manufactured blood,” Kilpatrick says.

A new way to manufacture red blood cells

More than 4.5 million people need blood transfusions in Canada and the U.S. annually. That’s where Shane Kilpatrick and his company, Membio, can help. The Canadian startup is developing technology to manufacture fully functioning red blood cells at an industrial scale.

“Researchers have been manufacturing blood in the lab for the last few decades,” says Kilpatrick. “But they haven’t been able to produce blood cost effectively at the scale needed to offset demand.” Membio is developing the bio-manufacturing processes for lab-produced blood cells that are pathogen and toxin free, and have a highly compatible profile.

Support from Velocity, an incubator at the University of Waterloo, as well as IndieBio, a San Francisco–based biotech incubator, have pushed Membio forward. Kilpatrick anticipates opening a new facility over the next 18 to 24 months.



Credit: UC San Diego

Power at your fingertips

A new wearable device turns the touch of a finger into a source of power for small electronics and sensors. Engineers at the University of California, San Diego, developed a thin, flexible strip worn on a fingertip that generates small amounts of electricity when a person's finger sweats or presses on it.

What's special about this sweat-fueled device is that it generates power even while the wearer is asleep. This is potentially significant for the field of wearables because researchers have now figured out how to harness the energy that can be extracted from human sweat even when a person is not moving. The device also generates extra power from light finger presses such as texting or playing piano.

"We envision this can be used in any daily activity involving touch, things that a person would normally do anyway while at work, at home, while watching TV or eating," said Joseph Wang, a professor of nanoengineering at the UC San Diego Jacobs School of Engineering and the study's senior author. "The goal is that this wearable will naturally work for you and you don't even have to think about it."

Each fingertip is packed with over a 1,000 sweat glands and can produce between 100 to 1,000 times more sweat than most other areas on the body. The reason we feel sweatier on other parts of the body is because those spots are not well ventilated. By contrast, the fingertips are always exposed to air, so the sweat evaporates as it comes out. The device collects this sweat before it evaporates and converts the chemicals within into electrical energy.

The device is a thin, flexible strip that can be wrapped around the fingertip like a Band-Aid. A padding of highly absorbent carbon foam electrodes collects the sweat. The electrodes are equipped with enzymes that trigger chemical reactions between lactate and oxygen molecules in sweat to generate electricity. Underneath the electrodes is a chip made of a piezoelectric material, which generates additional electrical energy when pressed. As the wearer sweats or presses on the strip, the electrical energy gets stored in a small capacitor and is discharged to other devices when needed.

The researchers say that this latest energy-harvesting technology is especially unique because it could serve as a power source anytime, anywhere. It does not have the same limitations as solar cells or thermoelectric generators.

OVERALL LONGEVITY RATES LINKED TO CHILD MORTALITY

According to researchers at Duke University in North Carolina, what's keeping human life expectancy growing has more to do with mathematics than popping vitamin supplements. Human average life expectancy has gone from a meager 40-ish years to a whopping 70-something since 1850. Data was compared from nine human populations and 30 populations of non-human primates and it showed that the increase in human life expectancy is more likely the statistical outcome of improved survival for children and young adults, not slowing the aging clock.

"Populations get older mostly because more individuals get through those early stages of life," said Susan Alberts, professor of Biology and Evolutionary Anthropology at Duke University and senior author of the paper. She found that the rate of aging is relatively fixed for a species, with very few individual variations. "We can't slow down the rate at which we're going to age," Alberts said. "What we can do is prevent babies from dying."

WEARABLE X-RAY DETECTOR MAKES ITS DEBUT

X-ray imaging is a fast and painless way for doctors to peer inside a person. But radiation detectors, which go under the body part being imaged, are rigid panels that contain harmful heavy metals, such as lead and cadmium. Now, researchers from Nanjing University in Jiangsu Province, China, have developed a proof-of-concept wearable X-ray detector prepared from nontoxic metal-organic frameworks layered between flexible plastic and gold electrodes for high-sensitivity sensing and imaging.

Most X-ray detectors are integrated into big, immobile instruments, such as computerized tomography and mammography equipment, or are stiff, like the sharp-edged mouth detectors used in dental offices. Detectors that could conform to rounded body parts or mold to the inside of confined spaces could be beneficial in some radiation monitoring and medical imaging applications.



Researchers zoom in on near-perfect electron microscope resolution

In 2018, Cornell researchers built a high-powered detector that, in combination with an algorithm-driven process called ptychography, set a world record by tripling the resolution of a state-of-the-art electron microscope.

As successful as it was, that approach had a weakness. It only worked with ultrathin samples that were a few atoms thick. Anything thicker would cause the electrons to scatter in ways that could not be disentangled.

Now a team, again led by David Muller, the Samuel B. Eckert Professor of Engineering, has bested its own record by a factor of two with an electron microscope pixel array detector (EMPAD) that incorporates even more sophisticated 3D reconstruction algorithms. The resolution is so fine-tuned, the only blurring that remains is the thermal jiggling of the atoms themselves.

“This opens up a whole lot of new measurement possibilities of things we’ve wanted to do for a very long time. It also solves a long-standing problem – undoing the multiple scattering of the beam in the sample, which Hans Bethe laid out in 1928 – that has blocked us from doing this in the past,” explained Miller.

Ptychography works by scanning overlapping scattering patterns from a material sample and looking for changes in the overlapping region. The detector is slightly defocused, blurring the beam, in order to capture the widest range of data possible. This data is then reconstructed via complex algorithms, resulting in an ultraprecise image with picometre (one-trillionth of a metre) precision.

The researchers could possibly top their record again by using a material that consists of heavier atoms, which wobble less, or by cooling down the sample. But even at zero temperature, atoms still have quantum fluctuations, so the improvement would not be very large.

This latest form of electron ptychography will enable scientists to locate individual atoms in all three dimensions when they might be otherwise hidden using other imaging methods. Researchers will also be able to find impurity atoms in unusual configurations and image them and their vibrations, one at a time. This could be particularly helpful in imaging semiconductors, catalysts and quantum materials – including those used in quantum computing – as well as for analyzing atoms at the boundaries where materials are joined together.

Study explores “multi-kingdom dialogue” among microbiota

The microbiome is comprised of microorganisms that live in and on us and contribute to human health and disease. Now, scientists from the National Institutes of Health (NIH) and their collaborators have identified an internal communication network in mammals that may regulate tissue repair and inflammation, providing new insights on how diseases such as obesity and inflammatory skin disorders develop.

The billions of organisms living on body surfaces such as the skin of mammals – collectively called microbiota – communicate with each other and the host immune system in a sophisticated network. According to the study, viruses integrated in the host genome, remnants of previous infections called endogenous retroviruses, can control how the host immune system and the microbiota interact, affecting tissue repair and antimicrobial defenses.

The newly discovered role of endogenous retroviruses adds to the scientific community’s understanding of certain diseases and inflammatory states and opens new research avenues.

Scientists from NIH’s National Institute of Allergy and Infectious Diseases (NIAID) led the project with collaborators from the NIH Center for Human Immunology, the National Cancer Institute, Stanford University and Scripps Research in California, University of Pennsylvania in Philadelphia, University of Oxford and The Francis Crick Institute in England.

Building on a series of studies over the past decade showing that microbiota broadly promote immune protection, the NIAID scientists and collaborators sought to discover how this occurs. They used *Staphylococcus epidermidis*, a common skin bacterium with known helpful and harmful features, as a study model in laboratory and mouse experiments.

The models helped them identify the important roles of skin cells called keratinocytes and of endogenous retroviruses in communication between microbiota and the skin immune system. Keratinocytes are the primary interface between the host and its microbiota. Their study showed that *S. epidermidis* triggered an antiviral response in keratinocytes, and that finding led them to discover that endogenous retroviruses coordinate responses to the microbiota that stimulate the immune system.

The mouse model also showed that a high-fat diet triggers an inflammatory immune response to *S. epidermidis* that can be controlled by providing antiretroviral treatment.



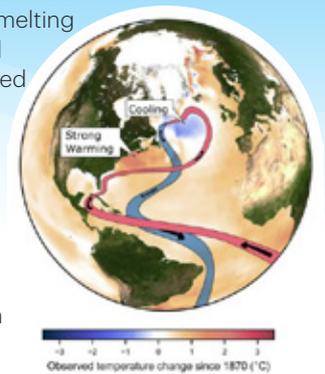
DISRUPTION OF ATLANTIC OCEAN CURRENTS WILL LEAD TO DRAMATIC WEATHER PATTERNS

Earlier this year, Germany's Potsdam Institute for Climate Impact Research (PIK) confirmed that the Atlantic meridional overturning circulation, or AMOC – part of the Gulf Stream – is the weakest it's been in more than 1,000 years. Scientists from Ireland, Britain and Germany compiled proxy data, taken from archives such as ocean sediments and ice cores, to reconstruct the history of the AMOC. From the evidence, they were able to determine that the current slowdown is unprecedented in the past millennium. The AMOC moves colder water southward, while the upper layers of the ocean distribute the warmer currents northward.

The ocean circulation directly affects weather patterns in Europe and regional sea levels in North America. "The Gulf Stream System works like a giant conveyor belt," explains Stefan Rahmstorf, initiator of the study published in *Nature Geoscience*. "It moves nearly 20 million cubic metres of water per second, almost a hundred times the Amazon flow." The impacts of climate change, such as the melting of the Greenland ice sheet, melting sea ice, increasing precipitation and river run-off, are contributing factors. These events caused substantial cooling of the northern Atlantic over the past 100 years, which has created a so-called "cold blob" that was predicted by climate models.

"If we continue to drive global warming, the Gulf Stream System will weaken further – 34 to 45 percent by 2100, according to the latest generation of climate models," Rahmstorf warns. "This could bring us dangerously close to the tipping point at which the flow becomes unstable." This could lead to severe consequences around the globe, due to the system's impact on weather systems and sea life.

The Institute's latest study, published in *Nature Climate Change*, introduces an early-warning indicator for critical transitions in the upcoming process. The question remains whether we can slow the rate of change.



Observed temperature change since 1870 (°C) IMAGE: Levke Caesar

TRACKING, AND CONTROLLING, CELLULAR HISTORY

Synthetic biology allows researchers to program cells to perform novel functions such as fluorescing in response to a particular chemical or producing drugs in response to disease markers. Now MIT engineers have taken it further by programming cells to remember and respond to a series of events.

These cells rely on enzymes called recombinases to enable them to remember, in the correct order, up to three different inputs. When activated by a specific input in the cell, such as a chemical signal, recombinases either delete or invert a stretch of the cell's DNA. Flipping or deleting those sites alters what will happen to the DNA if a second or third recombinase is later activated, enabling a cell's history to be determined by sequencing its DNA. Using this system, scientists can track cellular events that occur in a particular order, create environmental sensors that store complex histories, or program cellular trajectories.

Seeing the universe like never before

Scientists at the U.S. Department of Energy's Brookhaven National Laboratory have completed a 3.2 gigapixel sensor array for the camera that will be used in the Large Synoptic Survey Telescope (LSST), a massive telescope. Currently under construction on a mountaintop in Chile, LSST is designed to capture the most complete images of our universe that have ever been achieved.

"This is the biggest charge-coupled device (CCD) array that has ever been built," said Paul O'Connor, senior scientist at Brookhaven Lab's instrumentation division. "It's three billion pixels. No telescope has ever put this many sensors into one camera." The digital sensor array is composed of about 200 16-megapixel sensors, divided into 21 modules called "rafts." Each raft can function on its own, but when combined, they will view an area of sky that can fit more than 40 full moons in a single image. Researchers will stitch these images together to create a time-lapse movie of the complete visible universe.

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LEADING BLACK SCIENTISTS PUT CANADA'S RESEARCH ECOSYSTEM

UNDER THE MICROSCOPE

■ BY JANA MANOLAKOS

Since its launch over a year ago, more than 200 scientists have joined the Canadian Black Scientist Network, banding together in an effort to make science, technology, engineering and mathematics (STEM) fields more equitable. It's a small but mighty group, considering roughly 40,000 PhDs are awarded in Canada annually, and it falls far short of the 3.1 percent of Black people in a population of 38 million Canadians. Among these, Trevor Charles, Juliet Daniel, Lawrence Goodridge and Kiven Lukong, all network members and leading scientists, shared their experience and thoughts on Black representation in STEM.

DR. TREVOR C. CHARLES
 Professor, Department of Biology
 Director of Waterloo Centre for
 Microbial Research,
 and founder of the biotech company
 Metagenom Bio Life Science Inc.



I am a microbiologist. Our research group works on bacterial genome engineering for the conversion of food waste to biodegradable bioplastics; microbial degradation of the herbicide glyphosate; the microbiome of hydroponic vegetable production systems; and surveillance of COVID variants in wastewater.

Representation is important. It ensures diverse perspectives and reinforces the link between science and the Black

communities (we see how important this is during the pandemic). Black youth need to know that “scientist” is a potential career choice. Many Black families do not have any exposure to scientists, so the science career option is just not on the radar. There are also issues with streaming in schools.

Ultimately, we need to work on the entire pipeline, starting from the early years with exposure to science, and making connections by supporting organizations such as the Canadian Black Scientists Network.

ROLE MODEL:

Howard McCurdy was a microbiology professor at the University of Windsor, and federal MP.

DR. JULIET DANIEL
 Cancer Biologist and Associate Dean of Research
 and External Relations, Faculty of Science
 McMaster University

My cancer biology research led me to discover and name a new gene, “Kaiso,” coined from my favourite Caribbean music, “calypso.” Kaiso regulates the expression of genes that control cell proliferation, cell adhesion and cell motility, biological processes whose malfunction all contribute to cancer or human developmental disorders. Consequently, Kaiso’s malfunction in cells leads to developmental disorders, and aggressive tumour growth



Dr. Daniel with students

and spread in various human cancers (e.g., breast, colon, prostate). My team is currently studying the aggressive and difficult-to-treat triple negative breast cancers that are most prevalent in young women of African ancestry and Hispanic women – groups that despite a lower incidence and lifetime risk of breast cancer than Caucasian women, have a higher mortality rate from breast cancer. My current research seeks to determine if Black women have a genetic predisposition or susceptibility to aggressive breast cancer. I partner with The Olive Branch of Hope cancer support service in Toronto to organize “Think Beyond ‘Love Pink’ Breast Cancer Awareness” workshops for women of African ancestry in Ontario and the Caribbean.

Black scientists are important to the Canadian STEM research ecosystem because of their diversity of lived

experience, perspectives, research interests and global world views. Black scientists also enhance the diversity and type of STEM research questions pursued and studied, and they have different and diverse professional networks.

There are many possible explanations for the dearth of Black STEM scientists in Canada and “developed” countries in general. One obvious explanation is that many Black Canadian students do not see themselves reflected at the front of their elementary and high school classes, the lecture halls of university courses, or as positive role models in the media. This lack of Black academic and STEM representation has resulted in many gifted Black youth, with great potential to be scientists, thinking that they don’t have what it takes to excel as scientists and researchers.

Since there are so few Black STEM teachers, professors

and scientists, this means there are also limited mentoring opportunities for our young aspiring Black scientists. Due to decades of systemic racism with many Canadian institutions and organizations, many Black youth and their families also face financial barriers to accessing post-secondary education and if they are first-generation university students, they seldom have anyone to guide them on their academic and professional journeys.

All educational institutions need to have more representation of Black teachers and professors. The media also needs to do a better job and showcase more Black academic achievements and our contributions to STEM research and inventions, nationally and globally.

ROLE MODEL:

I have always admired and been inspired by Dr. Mae Jemison, the first Black female astronaut in space in 1992. So, I was incredibly excited and awestruck when I met her in person in 1999 at the Minority EXCEL Conference, at McGill University in Montreal when we were both plenary speakers.

DR. LAWRENCE GOODRIDGE

**Leung Family Professor in Food Safety
Director, Canadian Research Institute for Food Safety
University of Guelph**

My current research relates to developing a new way to detect foodborne outbreaks faster than the current approaches. The new approach combines wastewater-based epidemiology, in which wastewater is analyzed for the presence of disease-causing microorganisms using genomic approaches, with social media syndromic surveillance, in which social media posts are analyzed to identify posts describing symptoms consistent with foodborne illness. The new surveillance method will be used by the Public Health Agency of Canada to detect foodborne illness earlier. My research is also directly relevant to the COVID-19 pandemic, as the same approaches are being used to detect outbreaks of COVID-19 in near real time.

Black scientists are important to the Canadian STEM research ecosystem for many reasons. The first reason is the fact that Black scientists can take advantage of their rich cultural history to bring a perspective to science that is seldom realized. For example, in my field of food science, there is a need to identify new natural antimicrobial compounds that can be used to control the presence of pathogenic bacteria in foods. A rich diversity of such compounds exists in plant species that are native to African and Caribbean countries where many Black STEM scientists have descended from. These plant species and their potential use remain largely



unknown to the larger scientific community. Black scientists can use their knowledge to introduce this information to the community, enhancing scientific research.

Secondly, many Black people are treated every day for diseases and medical conditions based on the results of clinical trials that did not contain racially and ethnically diverse populations. The consequences of this include the fact that Black people may be exposed to serious unrecognized side effects and at a higher rate than white populations. Black scientists are keenly aware of such disparities and can conduct research aimed at developing knowledge regarding how medical treatments and drugs affect Black people specifically.

Finally, I have heard from many Black students regarding the lack of mentors who understand their unique struggles as they navigate higher education. Black STEM scientists can obviously fill this void.

One reason for the lack of Black STEM scientists in Canada is the lack of role models to emulate. We all grow up looking for mentors and role models that look like us, and in many cases, if a young person sees someone of the same gender or race in a profession, that can often be the impetus to decide on a career in that same profession. Additionally, due to a lack of champions, Black students are often not exposed to the potential for careers in STEM fields. This last point is often magnified in high school, where Black students are often not encouraged, and even steered away from pursuing science degrees at university.

I would like to see the traditional grant review process overhauled to remove the bias that too often exists in Tri-council grant review panels, which too often leads to Black scientists not awarded grants, despite the high quality of scholarship. Additionally, though progress has been made with respect to increasing diversity within the Canada Research Chairs program, additional steps must be taken to ensure that the best and most deserving Black scientists are not overlooked for the program. Black scientists are often not exposed to, or do not come from, the top labs in Canada, which puts them at a disadvantage for prestigious awards. Therefore, mentorship and leadership programs should be established to help well-qualified Black scientists develop the qualifications and skills needed to compete successfully for national and international awards, and also to progress to positions of leadership at Canadian universities.

ROLE MODEL:

Dr. Ernest Melville DuPorte, a ground-breaking entomologist and parasitologist who played a key role in establishing the world-renowned Institute of Parasitology at McGill University's Macdonald Campus in 1932, although he has rarely been recognized for his accomplishments.

Black youth and their families also face financial barriers to accessing post-secondary education and if they are first-generation university students, they seldom have anyone to guide them on their academic and professional journeys.

DR. KIVEN ERIQUE LUKONG

Professor, Biochemistry
PI: Signal transduction/Breast cancer
Department of Biochemistry, Microbiology & Immunology (BMI)
College of Medicine, University of Saskatchewan



The Lukong lab is a breast cancer research lab, with a focus on tyrosine kinases and their role in breast tumour formation and progression. Research in the lab is centered on breast tumours kinase (BRK) family Kinases (BFKs). The prototype member, BRK, is highly expressed in over 85 percent of breast tumours, but not in the normal mammary gland. The underlying cause behind this aberrant expression in breast cancers is unknown. The Lukong lab is investigating the cellular and physiological roles, and the mechanisms of action and modes of regulation of BEK in breast cancer, as well as the contribution of BRK in breast cancer drug resistance. Recent results from the Lukong lab indicate BRK as a viable therapeutic target in multiple-drug resistant-breast cancers.

First, all funding agencies must recognize that funding to Black researchers at all career levels is below representation. I know that a lot of effort is being done today to address equity, diversity and inclusion, but we are not yet there. Second, appoint Black scientists to top administrative positions or boards so that our voices can be heard and thus be visible role models.

The main goal is to increase the visibility of Blacks in STEM, identify role models and mentors and match them with mentees. There are fewer Black people in STEM than high positions in academia, private sectors or in the government. Young Black students start off strong and with a lot of enthusiasm in the undergraduate level, but start dropping out at the graduate levels because of the lack of role models in top positions. For example, I am the only Black professor in a department of about 30 faculty. There is a clear lack of representation of Blacks in STEM and other fields in all sectors. The Canadian Black Scientists Network is trying to change that.

ROLE MODEL:

I greatly admire the work that Dr. Juliet Daniel from McMaster University is doing. She is an experienced professor and skilled in molecular cell biology and cancer biology. Her research also focuses on the signaling roles of oncogenes in breast cancer. But above all, she is committed to improving equity, diversity and inclusion in higher education. BL



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■ BY TINA ADAMOPOULOS

About six months into her first year of university, Maydianne Andrade had her sights on a career in higher education. Thanks to an inspiring lecture from a biology professor, Andrade realized she could dive into the research she loved and share it with future students.

“I don’t know what it was, but in that lecture, the hairs on the back of my neck stood up, and I thought, ‘I can do that!’ That same professor became my research mentor and was important in the development of my feeling of belonging in science,” says Andrade, a professor in the Department of Biological Sciences at the University of Toronto Scarborough (UTSC).

As an evolutionary biologist, Andrade’s research gives insight into the mating behaviour of black widow spiders, particularly how males invest their lives in a single mating. She is currently studying plasticity and how male, black widows shift their development to adapt to changing environments and events, like rapid climate change.

When Andrade is not in her lab, she builds safe spaces to initiate local and national conversations about equity and inclusion in STEM. One of those initiatives is the Canadian Black Scientists Network, a national organization started by higher-education professionals last summer. With more than 200 members, its mission is to eliminate barriers for Black scientists through advocacy, mentorship and data collection.

The organization was also a response to rising acts of anti-Black racism and violence in the United States, and takes a critical lens to address systemic racism in Canadian institutions.

“Conversations have been going on for a while about the invisibility of Black scientists in Canada and elsewhere. The George Floyd murder was not new to those who are Black, but it was the extreme end of a continuum of challenges Black people face in various fields,” says Andrade, who is also president of the Network.

“Many of us decided that it was time to enact change because change was not happening very quickly.”

A 2017 study by York University highlighted Black students in the Toronto District School Board are streamed out of academic-level courses disproportionately.

“I want to see people encouraged to pursue their abilities, regardless of their identity.”
—Maydianne Andrade discusses diversity and inclusion in STEM

It found that 53 percent of Black students were in those courses compared to 81 percent of caucasian and 80 percent of other racialized students.

In addition, a Canadian Institutes of Health Research study that explored grant success of CIHR funding programs during 2018 and 2019 found that people who identify as visible minorities were less likely than others to receive a grant.

The Canadian Black Scientists Network recently teamed up with Statistics Canada to begin systematic data collection to identify where barriers and challenges exist across various fields, specifically in the early flow of people into STEM.

“We came together as a national coalition to make ourselves visible and to ensure we

have political power to discuss our needs and challenges with policymakers, granting agencies and institutions,” Andrade says.

Throughout her 21-year career, Andrade has mentored countless students and supported the University of Toronto community as UTSC’s vice-dean, faculty affairs and equity. Andrade co-chairs the Toronto Initiative for Diversity & Excellence (TIDE), a coalition of 15 faculty members at the University of Toronto who teamed up to advance equity, diversity, and inclusion. In the last two years, TIDE has held 50 engagements with faculty, staff and librarians.

“We saw the need to act as knowledge translators for our colleagues about the data on representation, bias and inclusion and on best practices for action and how that relates to the Canadian academic context,” Andrade says.

With input from TIDE researchers, Andrade has composed online unconscious bias training modules to discuss how stereotypes lead to discrimination and what systemic changes are required to rebuild working and learning environments. The project will launch nationally in the next six months.

Alongside research efforts, the Network will hold a national virtual conference, Black Excellence in STEM & Medicine (BE-STEMM), next year. The conference will highlight the innovative work of Black scientists across various fields, host a career fair and offer leadership panels to discuss how the industry for Black professionals can be improved.

For Andrade, having conversations about equity and diversity is the first step to initiate concrete change and promote inclusion – conversations she has with her students every day.

“I want to see people encouraged to pursue their abilities, regardless of their identity. I don’t think that is happening right now,” she concludes. **BL**



ENRICHING CANADA'S RESEARCH TAPESTRY WITH INDIGENOUS SCIENCE AND KNOWLEDGE

Increasing numbers of Canadian research and academic centres are collaborating with Indigenous communities, to everyone's benefit. Here are seven Indigenous initiatives that are making a difference.

Research Hub at the University of Alberta

At the University of Alberta, attended by some 1,300 Indigenous students each year, you'll find North America's only Faculty of Native Studies. The Indigenous Science, Technology, and Society (ISTS) program is an international research and teaching hub, with a mission to build scientific literacy by training graduate students, postdoctoral and community fellows to grapple with techno-scientific projects and topics that affect their territories, peoples, economies and institutions. It's also committed to producing research to inform national, global and Indigenous thought and policymaking in science and technology.

Funding agencies team up for equity, diversity and inclusivity

In January 2020, three funding agencies – the Canadian Institutes of Health Research, the Natural Sciences and Engineering Research Council of Canada (NSERC) and the Social Sciences and Humanities Research Council – launched an Indigenous strategic plan, “Setting new directions to support Indigenous research and research training in Canada,” which aims to ensure equity, diversity, and inclusion are considered in decision-making on research priorities, funding and grants, while building respectful research interactions.

“Of course, it will take more than our commitment to produce a deeper change and achieve a truly inclusive culture; it will take collective action across the research ecosystem,” explains Alejandro Adem, president of NSERC and chair of the Canada Research Coordinating Committee.

“Whether we are conducting research, studying at a post-secondary institution, developing policies or administering programs, we all have an important role to play in ensuring that Canada's research system supports and values participation by all.”

A First Nations data governance strategy

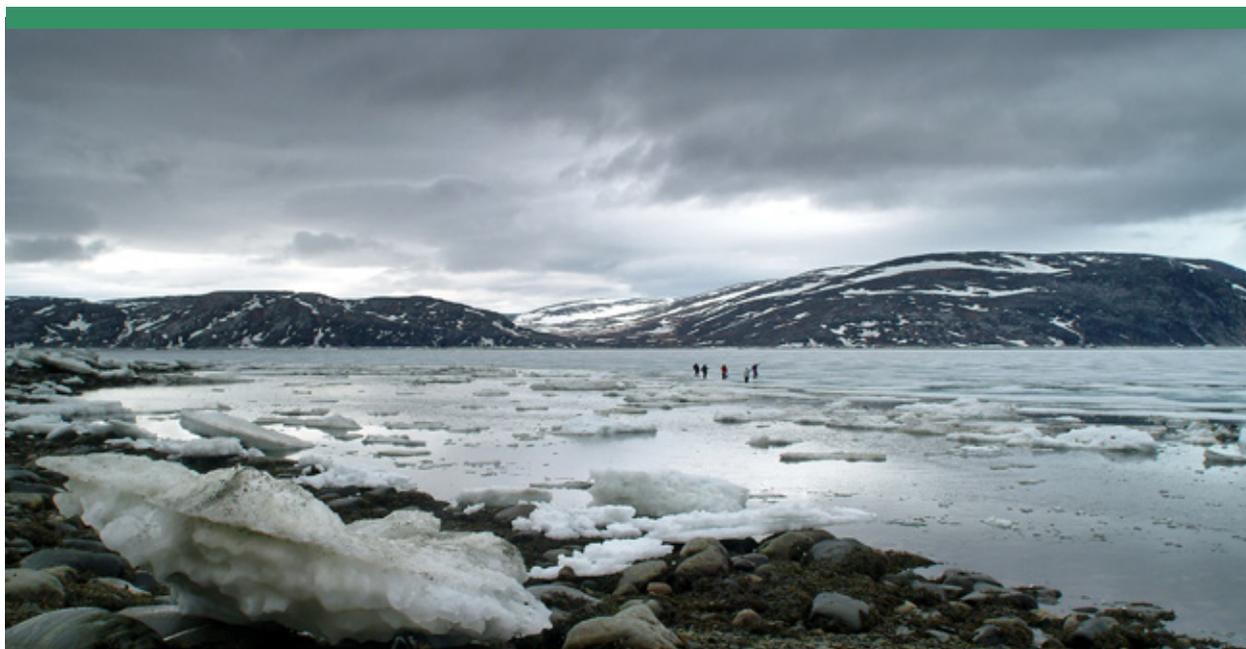
Last year, the First Nations Information Governance Centre (FNIGC) released a new national strategy on First Nation data sovereignty. “A First Nations Data Governance Strategy” envisions an Indigenous-led, national network of regional information governance centres for the information needs of First Nations people and communities.

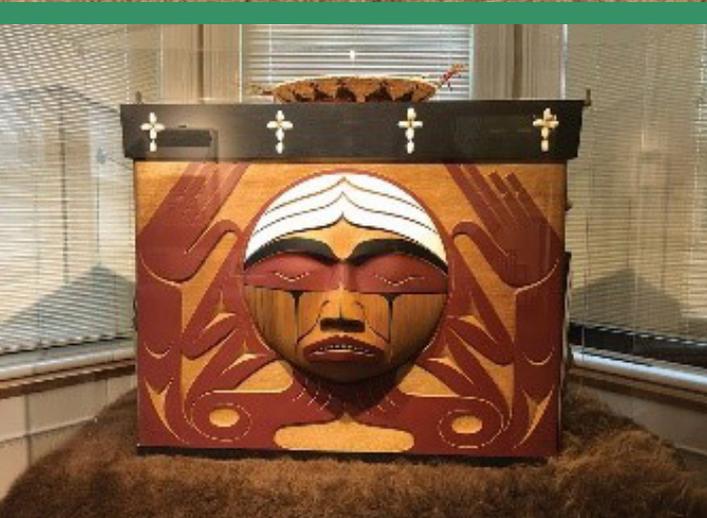
“This matters to Canada because – like all governments – First Nations governments cannot be successful if their rights to self-determination and self-governance are not empowered by the governance of their own data,” says Gwen Phillips, FNIGC board member and data governance champion for B.C.

In 1998, the centre introduced The First Nations Principles of OCAP (ownership, control, access and possession), which set out how First Nations' data and information will be collected, protected, used or shared on their territory.

The Peace–Athabasca Delta Institute

In Alberta, the communities of the Peace–Athabasca Delta region (Mikisew Cree and Athabasca Chipewyan First Nations, Fort Chipewyan Métis Association) see themselves as stewards of the delta and its ecosystem, and were a driving





Bentwood Box carved by Coast Salish artist Luke Marston (credit National Centre for Truth and Reconciliation)

force in pushing for the designation of Wood Buffalo National Park as a UNESCO World Heritage site.

The delta is considered a sacred place for the Athabasca Chipewyan First Nation and the Fort Chipewyan Métis; it's also an ecologically significant area that attracts armies of researchers. Now the group is working with local universities to establish the Peace–Athabasca Delta Institute as a place where Western and Indigenous research in the delta can work collaboratively.

Indigenous communities help expand knowledge for the Canadian Forest Service

The Laurentian Forestry Centre (LFC) is one of six research centres within the Canadian Forest Service which works mainly on forested land, areas that are populated by more than 70 percent of Canada's Indigenous people. In 2019, LFC teamed up with Laval University, to set out best practices and identify tools for conducting collaborative research with Indigenous peoples. Together with researchers and members of the Pessamit First Nation, they compiled a guide for working with Indigenous communities.

The guide, "Initiative for Knowledge Co-creation in Collaboration with Indigenous Communities," examines aspects of research processes, including first contact with the communities, formulating the research questions, identifying research objectives, collecting and analyzing data, and publishing results – all guided by the principles of ownership, control, access and possession.

Inuit research strategy supports studies into water, land and ice

The Inuit Tapiriit Kanatami (ITK), a national Inuit advocacy group, unveiled its National Inuit Strategy on Research in 2011, aimed at building partnerships with governments and research institutions that support studies in Inuit Nunangat, the Inuit homeland in Canada, which encompasses the regions of Nunavut, Nunavik in Northern Quebec, Nunatsiavut in Northern Labrador and the Inuvialuit Settlement Region of the Northwest Territories.

Last year, the group introduced the Inuit Nunangat Research Program, an Inuit-led initiative aimed at Inuit self-determination in research by supporting Inuit-designed projects and partnerships.

New Inuit Nunangat university planned

This past June, the ITK and the Mastercard Foundation announced plans for an Inuit Nunangat university, designed with Inuit customs and values in mind.

"The support of the Mastercard Foundation will allow Inuit the space, time and resources to determine how best to lead and plan for a new reality of higher education in Inuit Nunangat," said Natan Obed, president of ITK. The initiative will engage Inuit, regional leaders, educators, youth and experts over the next two years, as well as consult with Indigenous educators, education program development partners and research experts within Inuit Nunangat and internationally. **BL**



A trailblazing marine biologist

BY JANA MANOLAKOS

Somewhere along Canada's vast stretch of stark Arctic coastline, you'll find the tiny figure of biologist Emily Choy, scaling rocky ocean cliffs as she pursues the impacts of climate change on Arctic marine predators. From belugas to murre and kittiwakes, her work has taken her to remote locations across the Canadian Arctic – from the Devon Island, Nunavut, to Kendall Island in the Northwest Territories, and Coats Island in northern Hudson Bay. Fueled by curiosity and dedicated to the well-being of northern communities, she has been collaborating with local Inuit and Indigenous peoples to further her work on how climate change affects the Arctic ecosystem, specifically seabirds.

Choy was named an Explorer-in-Residence by The Royal Canadian Geographical Society this summer, becoming the first female scientist to earn the title since the society's founding in 1929. Her association with the society dates back to 2014, when she became involved in the Victoria Strait Expedition, which searched for the lost ships of the Franklin voyage. The trailblazing explorer is an NSERC and L'Oreal-UNESCO For Women in Science Research Excellence Postdoctoral Fellow at McGill University in Montreal.

WHAT'S THE SIGNIFICANCE OF BECOMING AN EXPLORER-IN-RESIDENCE?

It is a tremendous honour and as the first female scientist, I hope to inspire youth from diverse backgrounds to develop an interest in wildlife issues in the North. I also hope the support I receive will help to expand my partnerships with northern

communities with whom I've been very honoured to work.

WHAT TRIGGERED YOUR PURSUIT OF SCIENCE?

I've wanted to be a zoologist for as long as I can remember. I'm from Markham, Ontario, but grew up at my grandparents' cottage on Canal Lake in Bolsover, near Lake Simcoe. As a child, I'd spend hours catching frogs and snakes, fishing, and feeding chipmunks and chickadees at my grandparents' cottage. I developed a love for nature and the environment at a young age, which inspired me to pursue a life of science.

I never dreamed I'd work in the Arctic. I had the opportunity to work there during my Master's degree at the University of Ottawa under the supervision of Dr. Jules Blais, where I studied the ability of a large seabird colony to transport nutrients and contaminants to neighbouring ecosystems



through their guano. During my field work on Devon Island in Nunavut, I saw Arctic foxes, snow buntings, and polar bears, and was just captivated by the landscape and wildlife.

Afterwards, I did a PhD on beluga whales as sentinels of environmental change in the Beaufort Sea ecosystem, as part of a community-based monitoring program in partnership with Indigenous communities in the Inuvialuit Settlement Region of the Northwest Territories. I conducted most of my work at Inuvialuit hunting camps on Kendall Island in the Mackenzie Delta Beaufort Sea region, and studied the prey, body condition and diving physiology of beluga whales.

WHAT BARRIERS MUST STILL BE OVERCOME?

There are still many unknowns on the impacts of climate change to Arctic ecosystems, especially in regards to understanding the effects of multiple stressors on wildlife. For example, Arctic warming may not only result in increases in heat stress to seabirds such as thick-billed murres, but also increases in human activity such as ship traffic, which may overlap with their foraging areas.

WHAT ROLE DID YOU PLAY IN THE EXPEDITION?

I was a Weston scientist on the Victoria Strait Expedition. As part of my role, I presented my PhD research on beluga whales and partnerships with communities in the Inuvialuit Settlement Region for the expedition team, participated in scientific discussions, and conducted some marine mammal/seabird surveys. I was on the One Ocean Expeditions ship for approximately two weeks, and it was quite exciting to be a part of an expedition team with leaders and scientists from the Royal Canadian Geographical Society, The W. Garfield Weston Foundation, Parks Canada, The Arctic Research Foundation and other organizations.

A highlight during the expedition was seeing a mother polar bear with triplets – a possible sign that the polar bear population was doing well and healthy that year. Even though I didn't see any whales, I was happy to see many polar bears on the sea ice throughout the expedition.

Choy was named an Explorer-in-Residence by The Royal Canadian Geographical Society this summer, becoming the first female scientist to earn the title since the society's founding in 1929.

WHAT ARE YOUR CURRENT PROJECTS?

My research is on the effects of climate change on Arctic seabirds, primarily thick-billed murres. Most of my work is conducted at Coats Island in northern Hudson Bay, Nunavut.

WHAT EQUIPMENT DO YOU USE FOR FIELD WORK?

I am currently using biologgers, such as GPS accelerometers and heart rate loggers, to track the effects of climate-induced prey changes on the birds' energetics. I am also studying the direct effects of heat stress via Arctic warming on the birds using flow-through respirometry and a field metabolic system.

WHO ARE YOUR COLLABORATORS?

My research has many collaborators, including scientists from Environment and Climate Change Canada, the University of Quebec at Rimouski, the University of Windsor, and the University of Liverpool.

I am currently in the lab of Dr. Kyle Elliott at McGill University and am co-supervised by Dr. Grant Gilchrist from the National Wildlife Research Institute at Environment and Climate Change Canada. I work on a large team of highly qualified and passionate scientists that study seabirds in the Canadian North.

WHAT CAN WE LEARN FROM THE ARCTIC?

The Arctic is undergoing rapid change, and is warming at twice the global rate. The Arctic is known as an early warning system for the potential effects of climate change to southern regions, and many species which are extremely well adapted for living in cold harsh Arctic climates are sensitive to rapid environmental change. As a result, we are seeing the impacts of climate change in the Arctic occur faster than the rest of the world. **BL**

UNIVERSITY OF TORONTO STARTUP Winterlight Labs

DETECTS EARLY SIGNS OF BRAIN DISORDERS IN THE WAY WE SPEAK

■ BY CHERYL SAITO

Using speech to help unravel Alzheimer's disease, frontotemporal dementia, depression, bipolar disorder and schizophrenia, Winterlight Labs stands on the world's stage with its leading-edge technology.

The University of Toronto startup has received considerable interest from operators of senior care residences and big pharmaceutical companies for its development of a proprietary, tablet-based technology that assesses cognitive health (including memory, thinking and reasoning) by analyzing hundreds of language markers from short snippets of speech. What is also unique to the company's genetic makeup is that 70 percent of its employees are women.

Founded in 2015 by Frank Rudzicz, Katie Fraser, Liam Kaufman and Maria Yancheva, the organization includes a team of experts in computational linguistics, cognitive neuroscience and machine learning. Their novel AI technology platform quantifies speech and



With over
500,000
 Canadians living with
 dementia today, modelling
 projections predict numbers
 will increase to almost
one million
 by 2030.

language patterns to rapidly detect and monitor cognitive and mental diseases. Just one minute of speech allows Winterlight Labs to characterize the speaker's cognitive, acoustic and linguistic state, including lexical diversity, syntactic complexity, semantic content and articulation.

Only a few years into operations, Winterlight Labs has already signed agreements with Johnson & Johnson and biotech firm Alector to develop voice biomarkers for early-stage Alzheimer's disease and dementia. This year, the company has pole-vaulted into working with five of the top 10 biopharmaceutical companies in the world, including those in Japan, Switzerland, the United States and Germany.

Winterlight Labs' speech assessment is helping unravel medical mysteries in a dozen clinical studies. Psychiatric scales that rate conditions like geriatric depression and mood disorders, may not detect subtle changes in symptoms, which can slow the progress of drug development in neuroscience. Meanwhile, Winterlight Labs' technology, which focuses on over 550 features of speech and language, can measure fine-grained changes with their algorithms that traditional assessments cannot. These features are then used to classify heterogeneous disease populations into subgroups, track changes over time, and detect responses to treatment.

"Biopharmaceutical companies historically have had an 80 percent failure rate in clinical trials when it comes to responsiveness to disease modifying therapy," indicates Liam Kaufman, CEO. This equates to a 20 percent chance of success for a compound entering Phase I trials. Phase II development remains the largest hurdle in drug development, with just 28.9 percent of candidates achieving this critical phase. It isn't a particularly easy pill to swallow for companies aiming to fight disease.

"It's important to keep looking for objective means to measure cognitive function, and digital mental health therapy is on the increase using modern technology to improve the prevention and treatment of anxiety, depression and other mental health conditions," explains Kaufman.

This means partnering with several digital mental health start-ups. One of Winterlight Labs' largest projects at the moment is working with an organization called Cortexyme,

a clinical-stage biopharmaceutical company pioneering upstream therapeutic approaches for patients with Alzheimer's and other degenerative diseases.

"We are currently undergoing a clinical trial with 600 participants that will be completed at the end of September. What is unique about this trial is its different approach to the originating factors of Alzheimer's disease, which traditionally focus upon amyloid causes whereby proteins build up on organs like the heart, kidney and liver." Some researchers are exploring other potential causes, such as gum disease.

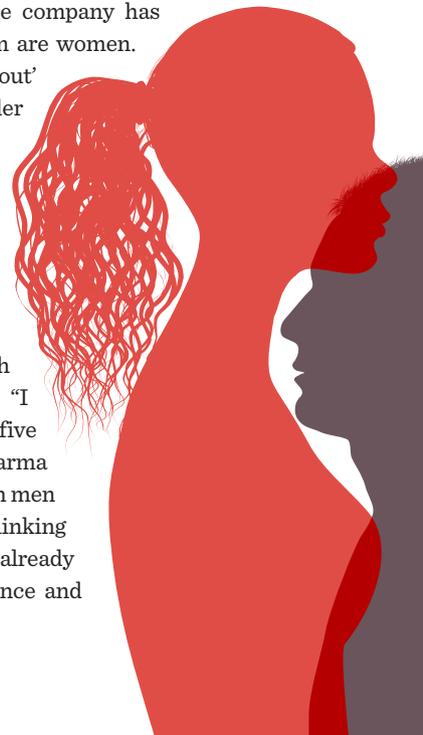
"Alzheimer's and other types of neurodegenerative conditions are one of the biggest challenges we are facing as a society, and it will only become a bigger problem in the future," explains Yancheva, the company's CTO. With over 500,000 Canadians living with dementia today, modelling projections predict numbers will increase to almost one million by 2030. And since more than 65 percent of these will be women, it is fitting that Winterlight Labs, a company focused on improving the lives of people with dementia and psychiatric illness, is predominantly female.

Kaufman recognizes that the company's gender diversity is unique. But he doesn't see it remaining this way in the pharmaceutical industry, with more and more women entering the field.

In 2016 only three women were in a senior executive role at 20 of the most profitable pharmaceutical companies. Not one of these companies had a female chief executive. Fast forward a few years and research among the top 10 pharmaceutical companies shows that the number of women executives grew to over 25 percent.

"At Winterlight, I can attribute our diversity to a couple of things. Firstly, the company has four co-founders, two of whom are women. Secondly, if people visit our 'About' page, they will see our gender diversity as representative of the company and likely identify with our organization as one in which they would like to work."

Kaufman believes that a culture of inclusivity and visibility for women in research can benefit any organization. "I truly believe that in the next five to 10 years, we will see bio-pharma science at a 50/50 split between men and women." It's a forward-thinking vision for a company that's already far ahead of the curve in science and gender diversity. **BL**



SANOFI LEADS IN CANADA'S VACCINE RACE

■ BY ROBERT PRICE

Canada's lagging capacity to manufacture its own coronavirus vaccines received a shot in the arm this March with Sanofi's announcement that it will be building a \$925-million vaccine manufacturing facility in Toronto. Weeks later, the push for domestically produced vaccines was answered with a new Biologics Manufacturing Centre in Montreal and Moderna's plans for a made-in-Canada vaccine manufacturing plant.

As vaccinations began rolling out in countries like Great Britain and the United States, Canadians were falling behind, dependent on imported vaccines that were often delayed and fell short of numbers ordered. It revealed the thinness of Canada's vaccine manufacturing capacity. The new Sanofi facility, expected to be operational by 2026, aims to fortify that capacity by increasing the supply of influenza vaccines.

Fabien Marino, vice president industrial affairs at Sanofi, says the investment represents a shared ambition by industry and government to build "a robust domestic biomanufacturing industry in Canada."

Canadian taxpayers will contribute almost half of the \$925 million needed to build the facility, a single investment which the federal government says represents one of the largest responses to threats of future pandemics.

Government spokesperson Sonia Noreau-Pérodeau points out that the COVID-19 pandemic highlighted the urgency for a strong domestic remanufacturing sector. "Investing in Sanofi helps address the need to secure a domestic partner for pandemic influenza vaccine readiness and will be key in contributing to Canada's long-term pandemic preparedness by installing the

capacity to produce pandemic influenza vaccine at population scale," explains Noreau-Pérodeau.

John Alderdice, manager of business retention and expansion at the City of Toronto, believes the city's well-established life science ecosystem helped to secure the Sanofi facility, ahead of other jurisdictions under consideration. "Sanofi is making a major investment in Toronto's life sciences sector as a result of our professional and experienced talent base, the quality of graduates from area universities, as well as the excellence of Toronto's scientific infrastructure, shared facilities and clinical research organizations," says Alderdice.

In addition to Toronto's Imagination, Manufacturing, Innovation and Technology Program, the municipality also works with other levels of government to help companies access relevant investments and supports. Alderdice explains, "This cooperative approach has helped the city secure major

SANOFI'S NEW VACCINE FACILITY BY THE NUMBERS

\$925 million (CAD)	Cost of the vaccine facility
\$455 million	Sanofi's investment
\$415 million	Federal government's investment
\$55 million	Ontario government's investment
\$79 million	Annual investment by Sanofi into Canadian research and development
2026	Expected opening date
1,225	Estimated new jobs



VIDO-InterVac researchers are working on prototype vaccines to combat the new coronavirus outbreak. (Photo: David Stobbe)

investments in facilities and encourage national networks to headquarter here.”

The robustness at the planned Sanofi facility comes in part from new technologies, including robotics, machine learning and improved data analytics. The company says these technologies will lend agility to its operations and help the company pivot to produce medicines when new emergencies arise; it fits into global efforts to increase flexibility and capacity in pandemic preparedness. “The COVID-19 pandemic is a perfect illustration of the global effort required, from the life sciences sector, public health institutions, governments, academia and the public to conquer this and other virulent diseases,” says Marino.

As part of this global effort, in March the federal government announced investments into vaccine production at the University of Saskatchewan’s infectious disease research centre, VIDO-InterVac. The centre received \$12 million to expand its vaccine manufacturing capacity, as well as \$11.3 million for continued operational funding for its high-containment laboratories.

“The \$12 million enables us to build the facility to Good Manufacturing Practices standards as required for human vaccine production,” said VIDO-InterVac Director Volker Gerdts. “We expect to begin vaccine production in a little more than a year.”

The Government of Saskatchewan also injected \$400,000 for VIDO-InterVac’s manufacturing facility.

Joining the push for domestically produced vaccines, construction of the new Biologics Manufacturing Centre in Montreal was completed this June, 10 months after breaking ground. Once it is

fully licensed and operational, the Biologics Manufacturing Centre will be able to produce cell-based biopharmaceuticals like vaccines and other biologics, including viral vector, protein subunit, virus-like particles and other recombinant proteins.

This August, biotech giant Moderna announced it would be working with the Canadian government to build a state-of-the-art messenger RNA (mRNA) vaccine manufacturing facility in Canada. The collaboration aims to provide Canadians with access to domestically manufactured mRNA vaccines against respiratory viruses including COVID-19, seasonal influenza, respiratory syncytial virus (RSV) and potential others.

Stéphane Bancel, CEO of Moderna, said, “As a company, we are committed to global public health. While we are still responding to this pandemic, we also want to ensure we and society learn from it. As Moderna expands internationally, we are delighted to bring mRNA manufacturing to Canada. We believe that this innovative business model will have global impact and implications.”

Other projects are also underway to achieve this goal. One of the largest involves Quebec-based biopharmaceutical company Medicago, which has experience developing rapid responses to emerging viruses, such as Ebola and H1N1. The company has received \$173 million in federal funding to move ahead with its COVID-19 vaccine research, and to establish a large-scale Canadian manufacturing facility in Quebec City. By the end of 2023, Medicago expects to be making vaccines from start to finish in the new manufacturing plant in the eastern part of Quebec City. **BL**

DNA barcoding critical in tracking and **understanding** new fungal skin infections

Sequence data helps scientists identify the origin and characteristics of individual fungal species infecting people

When it comes to work and research around DNA barcoding, you're not likely to find someone with as much experience, or someone who's made as much of an impact by linking genetics information, as Richard Summerbell. His achievements within the STEM field have been impressive and have consistently contributed toward the advancement and development of scientific research and application. And, although his career has spanned the better part of four decades, his penchant for figuring out how the biological world works continues to this day.

■ BY SEAN TARRY

Throughout his career, Summerbell has executed government-funded work for the Ontario Ministry of Health and the Dutch Ministry of Education and more recently with privately owned Canadian company, Sporometrics Inc. The laboratory provides microbiological testing services for environmental matrices including air, fluids and solid materials. It also supports Summerbell's most recent research, which leverages DNA barcoding to study the patterns of some populations of fungi that infect human skin.

Summerbell explains, "We've been tracking a good-sized outbreak in western Toronto, Brampton and Mississauga. It's all made possible by DNA barcoding because it's not really an organism that we can recognize reliably just using the microscope, as it resembles too many other things.

"It's a major nuisance that seems to have started in India in about 2017 or 2018," he says, explaining that it has proven to be resistant to common antifungal drugs. "It's a dermatophyte fungus that has an entity that was first described as a genetic group of an existing species. But it now has its own name: *Trichophyton indotinea*." The fungus causes a serious skin rash, usually on the upper body.

Not only has Summerbell made his mark within the STEM community, he's also served as a social trailblazer of sorts. A gay scientist, he belonged to the campus Gay Society at the University of British Columbia back in 1977 and was president of a group that called themselves the Gay People of UBC. He describes the latter group as an "activist" organization that was opposed to the repression and discrimination at the time.

He noticed changes after 1978, following the assassination of Harvey Milk, an openly gay American politician, and other civil rights events. Summerbell credits his own relatively barrier-free career to supportive and protective colleagues.

"Canada is quite a different place today compared to when I was starting my career," he explains. "The challenges that people face today are, in most cases, perhaps not as intense as they were 30 years ago. However, that's not to say that challenges aren't present. There are sometimes oppressive, systemic forces out there that daunt people from manifesting their interest in something like science. For true diversity to exist, it is important to support people of minority groups and offer the same opportunities to everyone." BL

ENCOURAGING DIVERSITY within STEM fields in Atlantic Canada

Landon Getz, a PhD candidate studying *Vibrio parahaemolyticus* environmental survival and host-pathogen interactions in the Thomas Lab at Dalhousie University, is passionate about his research. And, as a 2SLGBTQ+ advocate, he's also passionate about enhancing the equity, diversity and inclusion of STEM fields.

Through the founding of Queer Atlantic Canadian STEM, Getz is able to address each of his devotions, advancing STEM research and the LGBTQ+ community as well.

"One of the primary reasons for organizing QAtCanSTEM was because I believed that these resources, role models and communities were vital for 2SLGBTQ+ folks to feel comfortable in spaces that are primarily heterosexual, and historically – and in many places presently – dominated by white, cis, heterosexual men."

Growing up, and during his undergraduate studies, supports for lesbian, gay, bisexual, transgender, queer and two-spirited individuals were not readily available. Getz adds, "As with any experience or workplace, feeling comfortable, welcome and having good relationships with co-workers is going to be essential to doing good work. The resources and community QAtCanSTEM are trying to provide will help Queer folks become more comfortable, feel more welcome and build relationships in STEM workplaces."

MAKING SUPER-RESOLUTION IMAGING MORE AFFORDABLE

Bruker's new Vutara VXL comprehensive biological workstation for nanoscale biological imaging opens an affordable and easy-to-use path for both core facilities and individual investigators to enter the world of super-resolution imaging by incorporating Bruker's industry-leading single-molecule localization microscopy (SMLM) technology in a streamlined system with compact footprint. The new system enables research on DNA, RNA and proteins, from macromolecular complexes and super-structures, to chromatin structure and chromosomal substructures, to studying functional relationships in genomes and in various subcellular organelles. This novel system also supports advanced spatial biology research in extracellular matrix structures, extracellular vesicles (EV), virology, neuroscience and live-cell imaging.

bruker.com



NEW SONDE MAKES MONITORING A BREEZE

The YSI ProSwap Logger by Hoskin Scientific is a single-port monitoring sonde with built-in temperature and depth sensors. Designed for use with any single ProDSS Digital Smart Sensor, ProSwap Logger is a cost-effective and customizable monitoring solution combined with field-proven water-quality sensing technology. The device features a universal port for a wide variety of real-time monitoring applications, allowing users to combine any digital smart sensor with the built-in temperature and depth sensors for more comprehensive measurements in a slim profiling package. Customizable options allow users to build a dedicated system for conductivity, dissolved oxygen, pH, turbidity or algae monitoring applications.

hoskin.ca



SHINING A GREEN LIGHT ON NEW DISCOVERY

Driven by customer feedback, Beckman Coulter has introduced the Biomek i5 and i7 Automated Liquid Handling Workstations, along with compatible Windows-10 software. Designed to optimize dependability and walk-away time, it features a bright, multicolour status light bar that alerts lab workers to the instrument's current mode. An internal LED light illuminates the instrument deck for easy access and monitoring of workspace status. Among many other features, an off-set, rotating gripper optimizes access to high-density decks and onboard cameras enable live broadcast and on-error video capture to expedite response time and system diagnosis.

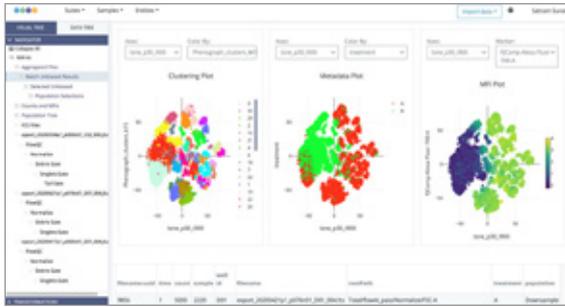
beckman.com



NEW INCUBATOR HELPS CELL THERAPY DEVELOPERS MEET STRINGENT CLEANROOM STANDARDS

Thermo Fisher Scientific recently launched its Heracell Vios CR CO₂ Incubator designed to address the need of biotechnology, biopharmaceutical and clinical laboratories for high-performance systems that meet stringent cleanroom and CGMP standards. As innovative research is being rapidly translated into promising therapies, there has been dramatic growth in demand for premium incubators that are suitably equipped for use in controlled environments. Thermo Fisher believes its incubator meets this need, offering leading-edge cleanability and CGMP-enabling features for cleanroom use. It's the latest step in Thermo Fisher's journey to better support cell therapy developers as they seek to bring innovative new therapeutics to patients.

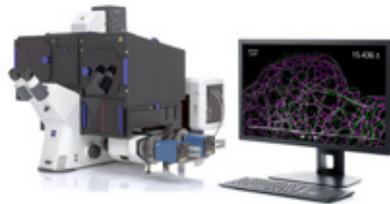
thermofisher.com



MAXIMIZING THE VALUE OF FLOW CYTOMETRY DATA

Aigenpulse has rolled out an update to its CytoML Experiment Suite that enables higher quality insights from cytometry data in research, analytical and process development, clinical development and manufacturing. It's an automated, end-to-end, machine learning solution specifically aimed at streamlining and automating flow cytometry analysis at scale and replacing manual gating processes, helping increase throughput of data processing and analytics by as much as 600 percent. Researchers need reproducible data to support a regulatory filing and this latest release introduces new unbiased analysis features to help uncover new insights by finding novel populations or clustering non-intuitive populations together.

aigenpulse.com



A NEW LIVE IMAGING SYSTEM PROMISES UNPRECEDENTED RESOLUTION

The new super-resolution microscope Elyra 7 by Zeiss takes science far beyond the diffraction limit of conventional microscopy. With

Lattice SIM researchers can now double the conventional SIM resolution and discriminate the finest sub-organelle structures, even those no more than 60 nm apart. It allows the observation of live cell dynamics at up to 255 fps, accelerates image acquisition in all three dimensions, allows the sharpest sectioning in wide-field microscopy and allows for a range of imaging techniques on one platform. Elyra 7 enables researchers to combine super-resolution and high-dynamic imaging – without the need for special sample preparation or expert knowledge of complex microscopy techniques.

zeiss.com

LABORATORY OVENS ENSURE SAFETY FOR WORKERS AND PROTECT SAMPLES

Cole-Parmer's new gravity convection ovens are ideal for sterilization and drying applications requiring a gentle airflow. A dual-wall door opens to 180° and features a double rack door handle for greater access to the oven chamber. Rounded inner chamber corners offer easy cleaning and optimum air flow. The oven controller provides safety and programmable convenience features such as user-specified start and stop, allowing lab workers to perform other laboratory tasks. The CLS (Custom Logical Safe)-Control system lets the safety system run independently of the CPU performance controller – in the event of CPU failure, so safety features are not compromised.

coleparmer.ca



LATEST IN LAB WATER PURIFICATION

MilliporeSigma has expanded its benchtop ultrapure water system portfolio, launching its new Milli-Q EQ 7000 Type 1 water purification system which it says is at the forefront of innovation in lab water purification. The new Milli-Q EQ 7000 system produces consistent ultrapure water quality that can be easily customized to meet experimental requirements. MilliporeSigma's Milli-Q Lab Water products provide reliable, high-quality sources of purified water for all scientists' needs. Among many features it includes new 'Check & Dispense' lights, a redesigned total organic carbon indicator and space saving options like a compact benchtop configuration or wall-mount.

sigmaaldrich.com



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ISSUE 3 • 2021

**CANADA'S
FOOD SUSTAINABILITY
REPORT CARD
& HOW WE CAN IMPROVE**



**NEW PRODUCTS,
INNOVATIONS AND
INDUSTRY BUZZ**





ENSURING ACCESS TO A SAFE AND SUSTAINABLE CANADIAN FOOD SUPPLY

FOOD integrity is an encompassing phrase that includes food security, food defense, food sustainability, food safety, food fraud and nutrition. These six elements are considered to be the pillars of food integrity, as they each contribute to ensuring authentic food. Providing assurance to consumers and other stakeholders regarding the integrity, authenticity, safety and quality of the food that we produce, import and consume is of prime importance in adding value to the Canadian agri-food economy.

As globalized food production continues to expand, the integrity of the Canadian food supply is under continuous threats, including imported foods from the U.S., such as romaine lettuce, that have caused national outbreaks of foodborne illness. In addition, food fraud – defined as the act of defrauding buyers (whether they be consumers, food manufacturers, retailers or importers) of food or ingredients for economic gain – has been problematic for the food industry throughout history. In Canada, seafood fraud is a major problem with public health implications. For example, several studies conducted at the University of Guelph have consistently found that a high percentage of fish sold in Canada is not the same species as listed on the label.

Climate change continues to challenge the sustainability of the Canadian food supply. The ongoing, severe drought in the Prairies has resulted in reduced availability of crops, leading to less quality and quantity available to consumers.

By Dr. Lawrence Goodridge

A systematic and interdisciplinary approach is needed to address issues of food adulteration (whether accidental or deliberate), as well as the effects of climate change on food sustainability, all of which diminish food integrity. Such an approach requires leading experts who can respond to acute crises in the food supply wherever they occur, and who can forestall potential threats before they emerge.

The Canadian Research Institute for Food Safety (CRIFS) at the University of Guelph aims to address challenges associated with the integrity of the Canadian food supply. By working with other departments, centres and institutes at UGuelph and other academic institutions, as well as external stakeholders, CRIFS embraces the three pillars of research, education and outreach to improve food integrity.

Research

A major focus of the CRIFS research program is the development of methods to detect foodborne outbreaks more quickly. The current foodborne outbreak surveillance approach, called the Surveillance Continuum, is a major impediment to the rapid detection of contaminated food, since it relies on sick individuals to seek medical care, and medical professionals to obtain samples, that when tested, yield the causative agent, triggering investigations to find the source of the suspect food. Breakdowns within the Surveillance Continuum (beginning with the fact that most sick people do not seek care) means that national foodborne surveillance networks, such as PulseNet Canada, operated by the Public Health Agency of Canada, are not alerted of an outbreak for an average of three to five weeks post-exposure, allowing contaminated food to remain in circulation, sickening increasing numbers of people.

Research at CRIFS is leading the development of a rapid, multifaceted and integrated approach to enhance foodborne outbreak detection, beginning with regular surveillance of wastewater samples to identify the presence of circulating bacterial, viral, and parasitic pathogens, and data mining of multiple social media sites for detection of keywords associated with foodborne illness such as diarrhea, stomach ache, nausea. Increased signals of wastewater monitoring, social media, or both, would trigger traditional epidemiological investigations to identify the suspected contaminated food, thereby effectively resolving the outbreak. The new surveillance approach will permit detection of outbreaks two to four weeks faster than the current Surveillance Continuum.

Education

Researchers at CRIFS teach within the Food Safety and Quality Assurance Program (FSQA), which is a one-year, course-based program that provides advanced training in food safety and

quality, and other aspects of food science and technology. FSQA students acquire knowledge of the fundamentals of food policy development, Canadian and international food law, applied aspects of total quality management, food safety management systems, risk analysis, and detection and epidemiology of foodborne pathogens.

Graduates of the program gain the necessary knowledge and requisite skills to serve as leaders in the domain of food integrity. Graduates are equipped to serve instrumental roles in the formation of public policies, the implementation of regulatory guidelines, industrial compliance with regulations and the regulatory strategies of companies looking to create a sustainable competitive advantage in the food industry, while developing effective strategies to combat issues associated with food integrity.

Service

Comprising a core of participants from industry, academia, research institutes, technology providers and a global network of stakeholders, CRIFS provides a coherent structure and process for assuring the food supply, through the sharing of information between stakeholder groups regarding Canadian food integrity, and implementation of projects to address research gaps by delivering commissioned projects, with the goal of establishing a self-sustaining global network of stakeholders to ensure maximum uptake and dissemination of research results.

The COVID-19 pandemic continues to place enormous pressure on the global food supply, with consequences for the production of safe foods, product mislabelling and disruption to the food supply chain. Modern, integrated approaches to address challenges associated with food integrity will help to alleviate the increasing challenges observed with production and dissemination of food. **BL**



Dr. Lawrence Goodridge is Director of the Canadian Research Institute for Food Safety and holds the Leung Family Professorship in Food Safety in the Department of Food Science at the University of Guelph.

INDIGENOUS-OWNED POTATO CHIPS A NEW SNACK ON TURTLE ISLAND

Soon, the Native Canadian Chip Corporation, an Indigenous-owned and -operated company will be bringing its Tomahawk Potato Chips to snack enthusiasts across Canada.

“I have been working on my ‘Tomahawk’ brand, which currently includes our potato chips, for over six years,” explains company founder Alfred Lea, who is First Nations from Pine Dock, Manitoba. “As a private-label company, we have found distribution to be a challenge,” he notes.

Based in Riverton, M.B., the company began distributing its Tomahawk brand chips in 2015 to parts of North America. A recently announced partnership with Star Wholesale, a Calgary-based national distributor, will place it on shelves across Canada.

“Star Wholesale now provides us with the ability to deliver directly to retail outlets across Canada reaching both mainstream and Indigenous markets,” adds Lea.

Tomahawk Chips are packaged in distinctive bags designed by Indigenous artists, and currently are sold in select retail outlets in Manitoba, Northern Ontario and California, with manufacturing facilities in Manitoba, Ontario and the U.S.

Native Canadian Chip Corporation is managed without government funding. While his enterprise continues to grow, Lea still operates with the original intent of using his entrepreneurial experience to inspire others, and he continues to support local community initiatives through Friendship Centres in Indigenous communities to help youth discover their own paths to success.



Big Mountain Foods aims to make plant-based foods more accessible



Mother-daughter-owned and -operated Big Mountain Foods hopes that expanding into a new, 70,000-sq.ft. facility in Delta, B.C., will boost international reach and make their plant-based foods more accessible. Led by Kimberly and Jasmine Chamberland, the natural vegan food manufacturer has partnered on the space with Loblaws and other large retail giants, while aiming to be a zero-waste facility by 2025.

“I am so proud of the expansion Big Mountain Foods has undergone to get to this point, and we are ready to move forward into a larger facility with the top talent in place to execute our product outreach strategy across the USA, Canada and Asia over the next five years,” says Kimberly Chamberland, CEO.

The company also just launched four new “Veggie Links” products across Canada and the U.S. The sausages, which come in styles from chorizo to bratwurst, are made from Saskatchewan-grown split peas and are certified vegan, gluten-, nut- and soy-free, and non-GMO verified. A strong commitment to sustainability won the Emerging Exporter Award from Business in Vancouver earlier this year.

Coming from four generations of entrepreneurial women, Big Mountain Foods also prides itself on being entirely female-owned and having a 90 percent female immigrant workforce.

More than ever, nutritional products are being purchased online



More than one-quarter of Canadian nutritional consumers – defined as those taking vitamins, minerals and supplements – say they are taking more supplements now than they did before COVID-19, while in the U.S. that number is as high as one-third, according to a new survey from packaging giant TricorBraun.

“COVID has intensified consumer focus on health, and as a result, consumption is up,” explained Becky Donner, the company’s senior vice president of marketing, design and engineering. The survey suggests that the top reasons for this change include consumer interest in balancing daily nutrition and preventing illness.

The survey polled more than 1,600 purchasers of vitamins, minerals and supplements in the U.S. and more than 800 in Canada. In addition to more demand for nutritional products, the survey showed that consumers were more likely to shop for these products online since the pandemic began.

“When COVID hit, sustainable packaging took a back seat to safety,” added Donner. “As consumers’ reliance on ecommerce and delivery continues, however, they are very conscious of their purchasing impacts on the environment, and we see that awareness growing among nutritional consumers. Sustainable packaging is re-emerging as a need versus a nice-to-have.”

Funding announced for Quebec food innovator

In a boost to Quebec's food economy, the federal government is injecting \$1,513,250 into the Quebec Agrifood Innovation Center (QAIC), a non-profit with expertise in food processing, agronomic research and support for biotechnology companies.

"QAIC is developing cutting-edge expertise in a number of emerging sectors. This support from the Government of Canada is essential for innovation and the development of these sectors as part of the new green and sustainable economy," explained Charles Lavigne, the organization's CEO.

A \$1-million contribution has been earmarked to help expand the province's fermented beverages industry. An additional \$156,000 will help QAIC's product development and marketing project for the emerging entomophagy sector aimed at promoting the human consumption of insects. The funding will be used to purchase and install laboratory equipment, including a centrifugal decanter and a lipid extraction press, as well as cover professional fees for training and installation work. A final \$357,250 will allow QAIC to continue operating during the COVID-19 crisis.



Research will include entomophagy product development to promote insects as food

UGuelph partners with Purity IQ to validate natural health product labels

The University of Guelph's Agriculture and Food Laboratory (AFL) is partnering with Purity-IQ to tackle ingredient identification and authentication issues that are challenging the natural health product (NHP) industry today. Driven by consumer demand for healthy foods and interest in food safety and sustainability, the growing NHP market has also led to concerns over product purity.

"Adding AFL as a commercial ISO 17025 lab service allows us to expand our existing probiotic species identity and authenticity services to the NHP industry. This will permit us to increase testing volumes, and provide quicker turnaround time," explained John Snow, Chief Operating Officer at Purity-IQ.

Purity-IQ aims to deliver innovative genomic (DNA) and metabolomic (NMR) analytical tools for industry to identify and authenticate products for consumers, protect biodiversity and ensure the sustainability of raw NHP ingredients.

The company says that the collaboration will create an academic, scientific and commercial powerhouse capable of delivering quality assurance tools that enhance brand trust with consumers.

INUIT FOOD SECURITY STRATEGY LAYS OUT STEPS TO A SUSTAINABLE FOOD SYSTEM

A new strategy aimed at ending hunger in Canada's Inuit homeland of Inuit Nunangat was recently unveiled by Inuit Tapiriit Kanatami (ITK), a large Inuit advocacy group. The Inuit Nunangat Food Security Strategy (INFSS) sets the foundation for ending hunger in these regions and supports Inuit-driven solutions for improved food security and sustainable food systems.

"The high rate of food insecurity for Inuit in Canada is unacceptable. The INFSS contains a series of transformative actions that, when undertaken concurrently, will have a significant impact on this terrible crisis. It identifies ways to support the development of an Inuit Nunangat food system approach that supports Inuit well-being and reflects our realities, priorities and way of life," explained ITK President, Natan Obed.

Food insecurity among Inuit is the result of poverty, high cost of living, climate change, inadequate infrastructure and systemic racism, which some say has grown into a public health crisis. The vast majority of foods Inuit consume are shipped thousands of kilometres by air and sea at a high cost, while a tremendous volume of food leaves the region through commercial export.

The strategy calls for coordinated actions and investments to address these imbalances, by supporting harvesting activities and Inuit wildlife management decision-making, subsidizing and regulating food transportation, improving food processing infrastructure locally and supporting regional food production through the development of local food markets.

For Inuit, the harvesting, processing and consumption of foods is deeply linked to community ethics and cultural identity. In tandem with this strategy, community leaders are working to ensure that the cost of living for Nunavimmiut is equal to Canadians living in the south.





IS CANADA REALLY A LEADER IN SUSTAINABLE FOOD PRODUCTION?

A new index offers proof

By Robert Price

Canada says it's a leader in the production of sustainable, environmentally conscious foods. But actually proving that claim may lie in a proposed National Index on Agri-Food Performance, one of the first in the world.

Canada's first agri-food sustainability index, a compilation of definitions, categories and standards, moved one step closer to becoming reality this June, following the release of a business case that signals the value of such an index.

Backed by a consortium of 34 private and public organizations, the index will provide empirical evidence that proves the sustainability of Canada's food system. It forms the cornerstone of a newly proposed Centre for Agri-Food Benchmarking, a soon-to-be authority on farm-to-retail sustainability.

Leading "a massive global trend"

In the near future, sustainability will dominate all discussions around food systems, say advocates of the index. Spurred by the Paris Accord on Emissions, UN Sustainable Development Goals, the Convention on Biological Diversity and other initiatives, governments around the world are demanding proof of sustainability before they'll accept exports from other countries like Canada. It's "a massive global trend," notes David McInnis, coordinator of the index and principal of DMci Strategies.

"If we're going to declare that Canada is one of the safest and most sustainable food systems on the planet, then we have to back it up," McInnis explains.

The keyword – sustainability – means different things to



different sectors. The index captures sustainability as it relates to four indicators: the environment, the economy, health and food safety, and well-being (a category that includes working conditions and animal care). McInnis says these four indicators provide a comprehensive view of sustainability that's necessary to tackle the challenges facing the food supply system.

"If you don't have healthy soil, then how can you be a resilient, sustainable food supplier? If you don't have good, healthy people working in the system, how can you have a sustainable workforce?" he asks.

One of the organizations involved in creating the index is the Canadian Produce Marketing Association (CPMA). Jane Proctor, vice president of policy and issue management at the CPMA, says the goals of the index dovetail with the philosophical

leanings of today's consumers. Who are increasingly interested in food that doesn't harm the environment. "I think there's going to be a rapid escalation among consumers to know that the food they're buying takes into consideration its impact on the climate, and on the ability to continue to produce food," Proctor explains. "Consumers want to make sure that we're not tearing down rainforests."

Proof is in the data

Bill Greuel, CEO of Protein Industries Canada, another organization involved in advancing the index, says the entire project is about providing proof to consumers and to export regions.

"It used to be fine for us to say, 'Look at us. We're Canadian

and we're sustainable." And if you looked at pictures of agriculture production in Western Canada, you could get there. That's not good enough anymore. We need to be able to prove it," he notes.

Other countries are devising their own sustainability measurements, but these initiatives tend to be focused on niche aspects of sustainability, like the practices of a particular sector. New Zealand, for example, measures export-dependent food sources, rather than whole-of-system metrics.

Proctor says that the diversity of stakeholders involved in developing the Canadian index – the consortium includes representatives from academia, retail, and a gamut of food producers and advocacy groups – lends credibility and authority to it. She believes the multi-sectoral approach itself makes a statement about the commitment Canadian producers make towards sustainability. "That establishes a way to demonstrate sustainability," Proctor explains.

Given the dire predictions governments around the world are making about climate change, the National Index on Agri-Food Performance may help the industry ward off some government interventions. If the industry can prove that it proactively champions sustainability, governments may be less likely to make demands or institute punitive measures to force compliance.

"This is a way of actually proving what the industry is doing, in a very quantitative way," says Proctor. "And increasingly, when you go to government and ask for something to be changed, they are looking for data to support that request."

The federal government also sees the proposed National Index on Agri-Food Performance as a tool for boosting Canada's sustainability credentials. "Enhancing trust globally in our agriculture and food system, with the data



“Look at us. We're Canadian and we're sustainable.' And if you looked at pictures of agriculture production in Western Canada, you could get there. That's not good enough anymore. We need to be able to prove it.”

to back it up, can enable our producers and processors to remain competitive and increase sales and exports, both globally and domestically,” says Samantha Seary, a spokesperson at Agriculture and Agri-Food Canada.

The business case for the index is the second step in a process of development and consultation. The first phase, which ended in January, affirmed the need for a national index and provided guidance on how to accomplish the project. With a governance framework provided by the business case, the next step involves establishing metrics for each of the four sustainability indicators. The index is expected to be published by late 2022. **BL**

SUNNY BOY FOODS ENLISTS RESEARCHER TO DEVELOP A UNIQUE FIBRE CONCENTRATE

By Cheryl Saito

WITH most Canadians not getting enough fibre in their diets and nearly half having high blood cholesterol, Alberta-based food manufacturer Sunny Boy Foods, a Canadian company dating back to 1926, recently teamed up with University of Alberta researcher Thava Vasanthan to bring a concentrated source of healthy dietary fibre to market.

Found within the cell walls of fungi, yeasts, bacteria and plants such as barley and oat, beta-glucan fibre is increasingly recognized for its health benefits in fighting an array of health problems, like high cholesterol, immune deficiencies, eczema and dermatitis.

To extract the potent fibre from grains such as barley and oats, Vasanthan developed an innovative process that does not use chemicals, and created a unique concentrated source of the fibre.

"It took a while for us to introduce this product into the market," said Vasanthan, who works in the Department of Agricultural, Food and Nutritional Science. "It was not well known to consumers, so we had to educate the industry to show them the benefits, how they can formulate their food products and put health claims on labels."

Last year, Sunny Boy Foods decided to incorporate the new technology for producing the concentrated fibre as part of their plan to evolve the company.

By implementing Vasanthan's beta-glucan extraction process – called air currents assisted particle separation (ACAPS), they are now selling the concentrate online and in some grocery stores under the product names of Nutrastat and Cerabeta, derived from oats and barley, respectively.

"Sunny Boy has been providing Canadians with nutritional breakfasts for over 90 years," says Brad Shapka, president of the

Thava Vasanthan's innovative process for extracting beta glucan from grains is now being used by an Alberta food company looking to capitalize on the fast-growing market for the beneficial dietary fibre.



IMAGE: Faculty of ALES

company. “With this new technology we can continue this tradition by providing Canadians with very-high fibre options based on the new scientifically proven benefits of beta-glucan.”

Driven by changing consumer demand for healthier options and a strategy to continue building globally competitive systems and technologies at Sunny Boy Foods, Shapka explains that including the new technology reflects the company’s “desire to maximize the value chain on Canadian-grown crops and our commitment to providing Canadians with natural, healthy products.”

Providing consumers with nutritious products comes at a cost for Sunny Boy Foods. The overall investments made by the company and its affiliates in various technologies is well over one million dollars. Much of that investment will also support new product development in coming years.

“Like many other industries in Alberta, Sunny Boy Foods is undergoing a global transformation,” explains Shapka, “and we believe that we can best optimize on the current opportunities through innovation.” Although their investment is large for a small Alberta company, they believe that by leveraging technology effectively, they can best respond to evolving consumer demand and maintain global competitiveness even if their market is mostly local.

With the beta-glucan market expected to grow significantly from 2021 to 2027, the trend for consumers to continue being mindful of healthy living is projected to grow along with it. Sunny Boy Foods aims to get a foothold ahead of that curve, helping Canadians get more fibre in their diets by providing the most effective, natural and beneficial fibre supplement on the market.

Shapka explains, “We are committed to seeking solutions that are responsive to evolving demand for healthier foods and nutraceutical options that are better for both our customers and the planet. And we believe this approach will enable us to build our sales both here in Canada and in global markets.” **BL**



PREVENTING FOOD FRAUD IN HONEY

Bruker recently released its NMR Honey-Profilng 3.0 module as a line of defense in protecting honey authenticity and brands. The new module expands the database to 28,000 honey samples, covering over 50 countries, 100 monofloral varieties and many polyfloral varieties. It allows honey producers and distributors to check for purity, botanical source and country of origin, and lets them identify atypical profiles for further investigation. Based on nuclear magnetic resonance spectroscopy, the screening tool evaluates honey identity and authenticity in one reliable, push-button method under full automation.

bruker.com

OIL-SOLUBLE GREEN TEA EXTRACT RESPONDS TO CONSUMER DEMAND FOR NATURAL SOURCES

More consumers want to purchase and consume foods made with ingredients from natural sources. For food manufacturers, this means finding replacements for traditionally used synthetic ingredients. When it comes to finding an alternative to traditional tocopherols, Kemins oil-soluble green tea extract for oxidation control combines the benefits of oil solubility with the antioxidant properties of traditional green tea extract. It also can replace conventional synthetic antioxidants such as tertiary butylhydroquinone. The heat-stable plant extract works in snack food and bakery products, oils, sauces and dressings to delay lipid oxidation, while lengthening the shelf life and maintaining consistency without negatively affecting taste.

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The MicroFlow III ductless workstation is a Class 1 ductless carbon-filtered workstation equipped with activated carbon filtration to eliminate, odours and non-hazardous chemical vapours. Completely self-contained with an integral recessed work surface to contain spills, it includes a powerful variable-speed fan and a filter replacement alert system. For user protection, a clear hood surrounds the work area and includes a hinged viewing sash that can be conformed for a microscope.

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The 3M Environmental Scrub Sampler with, a 10 mL-wide spectrum neutralizer, is one of the latest innovations for environmental microbial sampling applications. It effectively neutralizes commonly used sanitizers and allows for up to a 96-hour sample hold time. The scrub dots on the sampler are engineered to quickly and effectively disrupt biofilm while enhancing sample collection. It's designed to be compatible with 3M Petrifilm Plates and the 3M Molecular Detection System and is free from known allergenic components, PCR-inhibitors, animal-derived materials and components derived from genetically modified organisms.

3m.com



AI ENTERS PROFESSIONAL KITCHENS TO FIGHT FOOD WASTE

Winnow Vision, considered by some as the most advanced food waste technology on the market, uses artificial intelligence to maximize operational efficiency and data accuracy, reduce food waste and cut costs up to eight percent a year. The system validates each food waste entry, providing richer insight to help teams reduce waste. As more image data is gathered, Vision becomes smarter. When recognition capability is turned on, a state of semi-automation is reached where users are only required to confirm the suggested food. This reduces human error and saves time. Eventually, full automation will not require any input from the team.

winnowsolutions.com

HARNESSING CURIOSITY TO UNCOVER **THE HOLY GRAIL OF IMMUNOLOGY**

By Maria Madden

WHEN Dr. Tak Mak first entered the field of immunology, the widely held belief was that the immune system had little chance of fighting cancer.

By the 1980s, laboratories worldwide were pouring millions of dollars into unravelling one of the most challenging problems in immunology – deciphering how T-cells, an important part of the body’s immune response, recognize their targets via a structure or receptor embedded in the membrane of the cell.

“At the time, the genes encoding the T-cell receptor had proved so difficult to clone that the task was nicknamed: the holy grail of immunology,” explains Mak. “The odds were stacked against its discovery.”

In 1984, against all odds, Mak and his team at the Ontario Cancer Institute (OCI, now the Princess Margaret Cancer Centre), had a breakthrough. They isolated the gene that makes the human T-cell receptors, and in the process opened the door to a new era, making cell-based immunotherapy a medical reality and effective new form of cancer treatment.

“Nobody believed us, even people in our own department,” notes Mak of the discovery.

His T-cell receptors discovery remains the basis of research in tens of thousands of laboratories around the world. He has written over 1,000 publications and has been cited more than 120,000 times, making him the most cited scientist in Canada and among the most cited scientists worldwide.

Born in Hong Kong, his family moved to the United States in the 1960s, just as he entered university. Mak studied biochemistry and biophysics at the University of Wisconsin and University of Alberta. After earning his doctorate, he accepted a postdoctoral fellowship at the OCI in Toronto.

It was here, in the mid-1970s, that Mak worked in the laboratories of Canadian scientists Ernest McCulloch and James Till, the co-discoverers of hematopoietic stem cells. McCulloch became a mentor to Mak, teaching him to challenge dogma and combine careful and methodical approaches with free thought.

In the years that followed the discovery of the T-cell receptor, Mak continued to blaze a trail in the understanding of the molecular biology of the immune system and cancer at a cellular level, bringing that spirit of questioning the conventional with him.

His lab was also one of the first to generate genetically modified mice, known as “knockout” mice. They produced over 200 new knockout mice, which enabled scientists worldwide to study the effects of individual genes.



“Nobody believed us, even people in our own department”

These landmark discoveries, combined with those of his peers, have paved the way for research teams to battle cancer through immunotherapy, now considered the fourth pillar of cancer treatment – alongside surgery, chemotherapy and radiation therapy. Most notably, a T-cell-based approach, known as CAR (chimeric antigen receptor) T-cell therapy was approved to treat several types of blood cancer and offers hope to patients with a terminal diagnosis.

Mak continues his pursuit of scientific discovery as a senior scientist at the Princess Margaret Cancer Centre in Toronto. His most recent work includes a partnership with Kevin Tracey, a neurosurgeon at the Feinstein Institute for Medical Research in Manhasset, N.Y. Together with collaborators, the two scientists have uncovered the mechanisms whereby the brain talks to the immune system, solving a puzzle that scientists have pondered for more than a century.

“We believe it’s an entirely new lens through which to look at numerous diseases including cancer, viral infections and autoimmune conditions,” explains Mak.

Mak’s lab is also studying how mutations in a particular digestive enzyme drive the development of certain types of leukemia and lymphoma, dissecting the pathways that lead to these cancers and how to potentially reverse them. To this aim, he cofounded Agios, a drug development company that has two FDA-approved medicines for the treatment of terminal leukemia patients.

Where does that spark of ingenuity come from? For Mak, it comes down to curiosity, outstanding trainees and colleagues, as well as trying to make connections between all scientific disciplines. “There are no limits to profound questions we can ask about science and the future,” he explains.

Of the mysteries that he himself has played a role in unravelling, Mak says, “Those are the moments that make years of hard work worthwhile.” **BL**

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