

BioLAB BUSINESS

2019



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Women *in* Charge

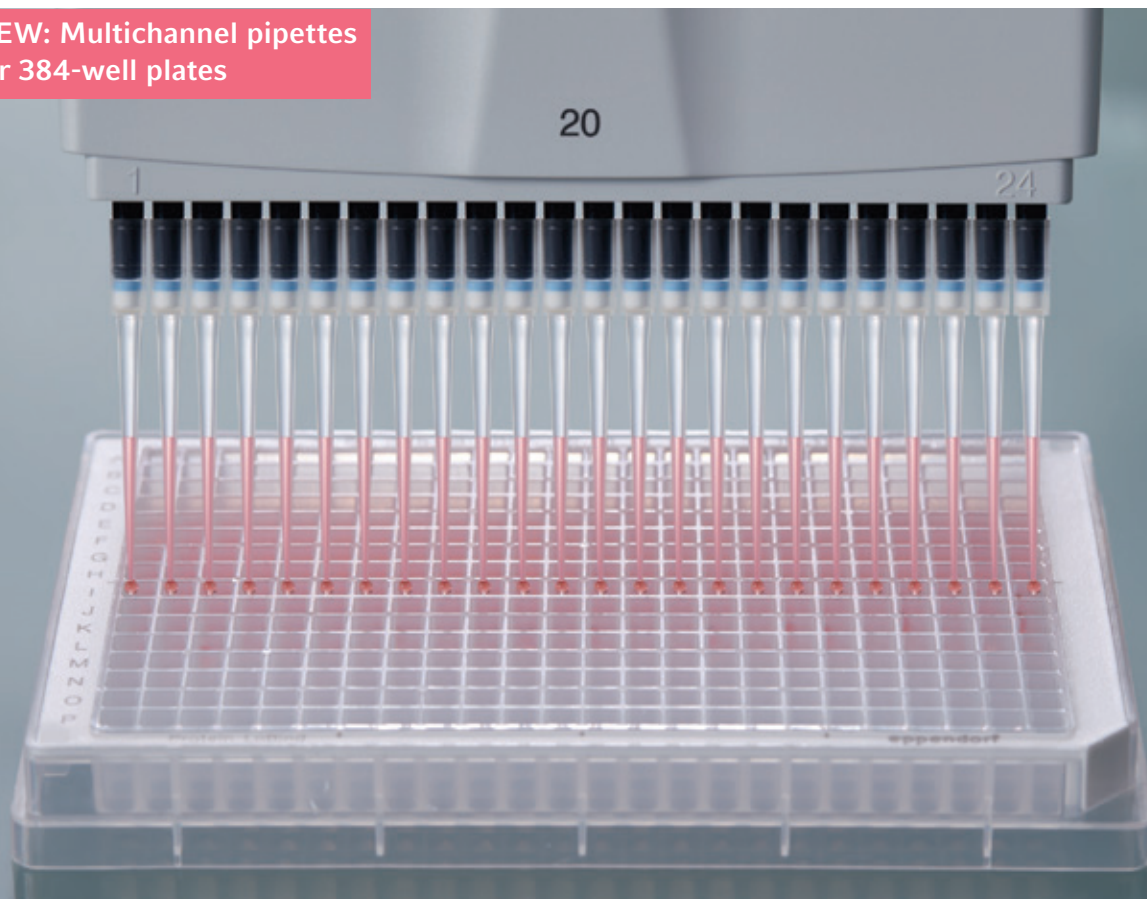
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BETTER LATE THAN NEVER

■ BY POPI BOWMAN

Thirty-five years may not sound like a long time to some of us, but in the lifetime of a magazine, it's an eternity (especially these days). Knowing that this year is the 35th anniversary for *BioLab Business*, I was even more excited because we were also planning our first-ever women's issue – focusing on the accomplishments of Canadian women in STEM and, for our expanded *Canadian Food Business* section (starting on p.29), the world of food. In many cases the two intersect, such as in our Application Note feature about Genecis, a woman-founded startup based in Ontario that is turning food waste into bioplastics.

For "Canada's Leading Ladies of STEM" on p.11, we look at 10 barrier-breaking women who have changed the world – whether everyone knows their names, or not. As we did the research for this issue, I realized there was no way we could fit all of the amazing women we found into one magazine, so we'll plan on another women's issue long before the next 35 years passes! As they say: Better late than never.

Recent news events also spoke to our theme, and the obstacles that women face: On the one hand, we celebrated that the first-ever, all-female space walk was planned. Then – oops! – there weren't enough spacesuits in the right size, so it was cancelled. In California, a new law was passed in late 2018 requiring publicly traded firms to place at least one woman on their board of directors by the end of this year; companies with five directors must add two women by the end of 2021, and companies with six or more will need to add at least three. Those who don't will face a penalty.

It's unfortunate that some companies have to be forced to take action, but sometimes a nudge is all it takes to raise awareness. And there's always pushback, such as complaints that legislation might allow unqualified candidates to take important positions in the name of equality. The strongest argument against that statement is this magazine: Nowhere between these covers will you find an unqualified woman, and yet many of them "fly under the radar" in the public eye.

The gender divide isn't a matter of opinion or a feminist soapbox: The statistics are loud and clear. For example, *Fortune* magazine reported that in 2016, VCs invested \$58.2 billion in companies with all-male founders, compared to a mere \$1.46 billion for those founded by women. So we wanted to do our part to champion those women who might not find themselves on the Top 10 lists and front pages, simply due to the over-saturation of an industry dominated by Y chromosomes.

We'll continue to seek out interesting projects and people to include in our magazine, regardless of ethnicity, gender, sexual orientation or any other label that might generate bias – and, whenever we can, we'll dig to find the undiscovered heroes whose scientific work is changing the world, even if they're "behind the scenes."

Unfortunately we can't include everyone, but suggestions are always welcome for future editions of *BioLab Business*. I welcome pitches, suggestions, compliments and (if you must!) complaints at: pbowman@jesmar.com.



Popi Bowman
MANAGING EDITOR

CREATING "SHE-ROES"

■ BY DR. WENDY WATSON-WRIGHT, CEO OF THE OCEAN FRONTIER INSTITUTE



In 2016, the Peterson Institute for International Economics, a Washington-based think tank, released a study that identified a positive correlation between the proportion of women in corporate leadership and a firm's profitability. According to their research, businesses that moved from having no female leaders to a representation of 30 percent realized, on average, a 15 percent increase in net revenue.

The ocean accounts for 2.5 percent of the world's Gross Added Value (GAV). Consider for a moment that if the Peterson study is correct, what potential economic benefits could be generated if more ocean resource management was conducted by women. There's growing recognition that if sustainable ocean development is to achieve its potential, we must diversify all aspects of ocean activities: policy, advocacy, tourism, resource development including oil and gas, fisheries and politics.

In Canada, the federal government recognizes this value, advocating that labour market conditions and higher earnings will occur from a more diverse workforce. As a result, there's a significant push underway to encourage more female participation in STEM-related careers (science, technology, engineering, mathematics). It's not an easy task. According to UNESCO (2017), only 35 percent of STEM students in higher education are women.

What must we do to get more women involved in science, and help us mitigate the challenges and leverage the economic opportunity? Maya Angelou once said it is important "to recognize and celebrate our heroes and she-roes." And it's the concept of "celebrate" that we need to focus on.

For example, James Cameron and Jacques Cousteau are recognized for their work in ocean science (Cameron for exploring the Mariana Trench; Cousteau for inventing the Aqua Lung and advancing ocean research). However, their celebrity occurred not just because of what they achieved, but because they were very good at communicating – packaging their science into sound bites and capturing the public's imagination. They shared their passion for the ocean in interesting and entertaining ways.

Marine biologists Sylvia Earle and Rachel Carson also understood the power of effective storytelling. They knew that taking action on sustainable ocean practices was effective only if public awareness, and support, also occurred. Ms. Carson and Ms. Earle were early "she-roes." We must follow their example if we're to attract young female talent to ocean resource management, and other STEM fields.

We need to encourage women whose talent, passion, knowledge, know-how and tenacity will help us find solutions to the issues that challenge us. We must reward women who use innovation and the principles of sustainable development to create new economic opportunities.

And we must encourage women to become comfortable with taking centre stage, because it is through recognition that we can counter long-standing biases and gender stereotypes that are steering women away from science-related fields. Being in the spotlight is not always comfortable, but it's essential if we're to develop the ocean frontier in a way that generates social and economic benefits in an environmentally responsible manner. **BL**

According to UNESCO (2017), only

35 percent

of STEM students in higher education are

women.



"There's growing recognition that if sustainable ocean development is to achieve its potential, we must diversify all aspects of ocean activities: **policy, advocacy, tourism, resource development including oil and gas, fisheries and politics.**"

BY DAVID SUZUKI WITH
CONTRIBUTIONS FROM
IAN HANINGTON



A TRIBUTE TO TARA CULLIS

Because I've hosted TV and radio science programs for decades, I get a lot of public and media attention. And I've done my best to leverage that to highlight critical issues I care about. But today, I'm turning the spotlight on the real hero behind the organization that bears my name: Tara Cullis, my beloved wife.

The David Suzuki Foundation was Tara's brainchild. It would never have launched or achieved so many protections for what we all need to survive without her guts, determination and amazing smarts. I'm the face of this organization. But Tara is the brains and its muscle.

I can still hear Tara's voice in my head: "David, you can't keep harping on problems. It's time to talk solutions." This was after I hosted a five-part CBC radio series *It's a Matter of Survival* in 1989 about global environmental problems, including climate change. Listeners flooded the network with thousands of letters asking what to do. (This was before email!)

Inspired, Tara rounded up friends, activists and thinkers to brainstorm for a new environmental organization, unlike any other. Her mantra: "Let's battle problems at the source." And she answered every single one of those letters, inviting people to take part in the vision. To our amazement, people sent money to support us!

In the early days, when we had a tiny office above an auto body shop, Tara was at the helm, leading a handful of passionate volunteers. Everything fell on her shoulders, and she met every challenge. She jumped in with both feet, learned by doing and worked around the clock, sometimes staying in the office until early morning.

Tara continues to shepherd the Foundation (and me!) as president of its Board and galvanize the hundreds of staff and volunteers.

Foundation staff laud me as their longest-term volunteer. But Tara truly deserves all honours. She's my touchstone. I would not be who I am without her. She is tireless. And fearless. I am filled with awe and admiration for her idealism and energy to get things done. And she chose me to be her life partner!! I couldn't be more grateful for her in my life.

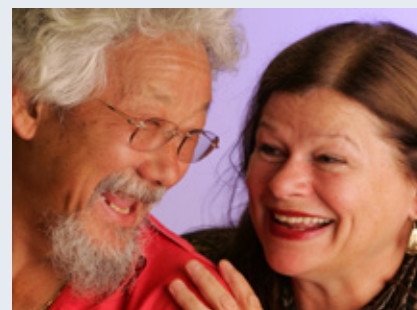
Tara turned 70 this year. Please join me in wishing her well for her milestone birthday. **BL**

BEHIND EVERY GREAT MAN...

An award-winning writer and former faculty member of Harvard University, Dr. Tara Cullis has been a key player in environmental movements in the Amazon, Southeast Asia, Japan and British Columbia.

She was a founder of the Turning Point Initiative, now known as the Coastal First Nations Great Bear Initiative. This brought First Nations of British Columbia's central and northern coasts into a historic alliance, protecting the ecology of the region known as the Great Bear Rainforest. Cullis has been adopted and named by Haida, Gitga'at, Heltsuk and Nam'gis First Nations.

Cullis also founded or co-founded nine other organizations before co-founding the David Suzuki Foundation in 1990. Both of their daughters have served on the Foundation board: Dr. Sarika Cullis-Suzuki is a marine biologist and educator, while Severn Cullis-Suzuki is also an environmental activist who gained attention on the world stage when she presented to the UN Rio Earth Summit in 1992, at the age of 12.



Dr. David Suzuki is a scientist, broadcaster, author, and co-founder of the David Suzuki Foundation.

Ian Hanington is Senior Editor, David Suzuki Foundation. Learn more at www.davidsuzuki.org.

ONTARIO CUTS FUNDING FOR ARTIFICIAL INTELLIGENCE AND STEM CELL RESEARCH

The Ontario government recently announced a \$24 million cut to the Vector Institute for Artificial Intelligence, another \$4 million cut for the Canadian Institute for Advanced Research, which is charged with overseeing a Pan-Canadian AI Strategy, and a cut of \$5 million in annual funding to The Ontario Institute for Regenerative Medicine, which focuses on stem cell science. Vector signed an agreement for \$30 million with the previous Liberals for workforce development, AI master's programs and scholarships. It has since received only \$10 million from the current government; and there is no more coming according to provincial expenditure estimates – part of the Tories effort to eliminate a \$11.7 billion deficit. The Vector Institute says it will be able to continue programs and manage, despite reduced provincial funding.



CANADIAN GEOCHEMIST WINS 2019 GERHARD HERZBERG GOLD MEDAL

In 2016, Canadian scientists descended three kilometres below the surface at Kidd Mine near Timmins, Ontario, in search of water, deep in the Precambrian rock. Much like Jules Verne's characters in *Journey to the Centre of the Earth*, they rode vehicles down a sloping corkscrew path into the spell-binding world of a long-gone primordial ocean floor, where water bubbling with hydrogen and sulfate gases had the potential to support life. At this subterranean level the team was astonished to find very salty, free-flowing water that smelled musty. Even more dramatically, it was over 2 billion years old, the oldest ever discovered.

The exploration was triggered by research carried out by geochemist Dr. Barbara Sherwood Lollar, Canada Research Chair in Isotope Geochemistry of the Earth and the Environment. Her work involves probing water samples from mines for microbes that survive without sunlight, and applying new techniques to pinpoint the source of groundwater pollution.

It's work for which in part she was awarded the 2019 Gerhard Herzberg Canada Gold Medal for Science and Engineering this May – along with recognizing her contribution to shaping space exploration and the search for life on other worlds. The earth sciences professor is only the second woman to win the NSERC award in its 28-year history.

In collaboration with an international team of scientists, Dr. Sherwood Lollar also reported the first direct evidence that communities of microbes known as chemolithotrophs survive by using hydrogen and minerals deep inside crystalline rocks.

"The work being done in Canada to understand the subsurface of our planet is helping to shed light on possible ways to both sustain the earth's water resources," she explains, "but also to explore other planets and the extraterrestrial real estate."

In 2016, Dr. Sherwood Lollar was named as a Companion of the Order of Canada "for her revolutionary contributions to geochemistry, notably in the development of innovative mechanisms for groundwater remediation, and for her discovery of ancient fluids that hold implications for life on other planets." Also in 2016, she was awarded the Bancroft Award by the Royal Society of Canada. She received the Logan Medal in 2018.

Dr. Sherwood Lollar says that it's important for scientists to build resilience against self-doubt and other barriers. In a *Globe and Mail* interview, she specifically pointed to challenges faced by female scientists: "There are places where the needle still isn't shifting. A lot of people have been opening doors, but I think that perhaps what we're recognizing as a society is that some of the things inside of those doors need to change, too."

SUMMER LAB FOR WOMEN IN AI

Montreal-based accelerator OSMO has partnered with CIFAR to expand its AI For Good Summer Lab program right across Canada. It's the first lab of its kind, opening doors to leading minds in AI for a cohort of up to 30 undergraduate women in STEM. "Diversity has a pivotal role to play in the development of responsible, inclusive and transformative AI," says Dr. Elissa Strome, AVP research and executive director of the CIFAR Pan-Canadian AI Strategy. CIFAR will provide financial and in-kind support of \$300,000 over three years to the program to bolster the expansion so that more women in AI can access support, opportunities and connections; and, develop their AI leadership with an emphasis on making a positive impact on society. Through its partnership with CIFAR, the AI For Good Summer Lab program will be included under the national program of activities as part of the CIFAR Pan-Canadian AI Strategy.

CIFAR will provide financial and in-kind support of \$300,000 over three years to the program.

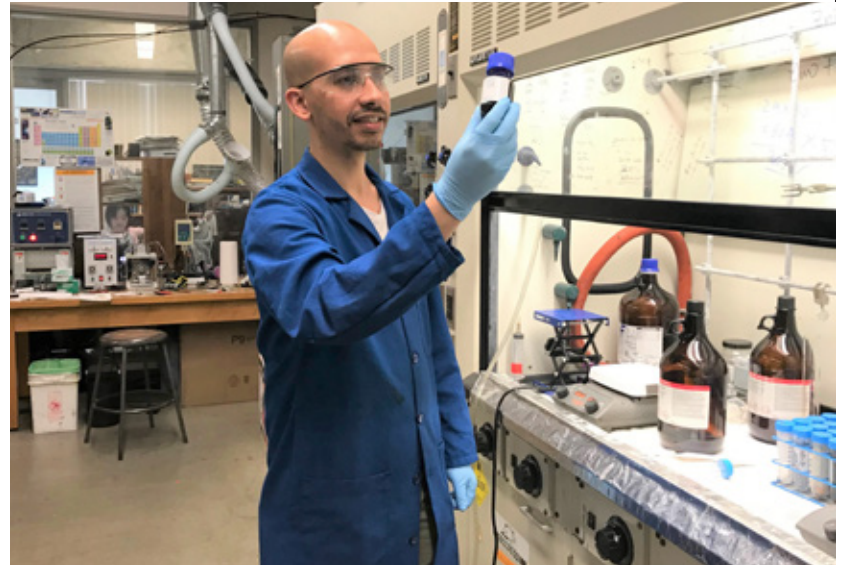
IBM TACKLES THE PLASTIC PROBLEM

VolCat is a new technology developed by IBM researchers, which turns PET (one of the most common manufactured plastic polymers) into a renewable resource. The catalytic chemical process digests polyesters into a substance that can be fed back into plastic manufacturing machines to make new products. The VolCat system also eliminates the need to sort or clean the plastics; they are simply ground up and then separated from contaminants during the process.

Of more than 272 million metric tons of plastic that are produced each year globally, about one-quarter is PET, which is commonly used for water bottles and packaging.



LAB-GROWN HEART PATCHES READY FOR HUMAN TRIALS



Maher El-Kady in the UCLA laboratory. He holds conductive ink that can be used for printing flexible electronics. The researchers used 3D printing to design the device. Credit: Mit Muni/UCLA

NEW TRIBOELECTRIC NANOGENERATOR HARVESTS ENERGY FROM SNOWFALL

You may have heard of triboelectric nanogenerators (TEGs) that generate electricity from raindrops, footsteps and other physical movement; now, UCLA researchers and their colleagues (including Dr. Ravi Selvaganapathy, professor and Canada Research Chair in Biomicrofluidics at McMaster University) have designed a device that creates electricity from falling snow. Because snow is positively charged, and silicone is negatively charged, when the two substances interact, an electrical charge is created. Using 3D printing, the research team incorporated a layer of silicone with an electrode to capture the charge, creating a flexible, stretchable and metal-free device. The first-of-its-kind nanogenerator also acts as a weather station, and can tell when a person is walking, running, jumping or marching. The new device could be integrated into solar panels to provide a continuous power supply when it snows, and can also be used for monitoring winter sports, such as skiing, to more precisely assess and improve an athlete's performance. The team's findings are published in the June edition of *Nano Energy*.

Watch for the next issue of BioLab Business, when we take a deeper look at some of the world's energy leaders, and developments that could change the way we power our planet.

Researchers led by Professor Sian Harding at Imperial College London have developed a way to grow thumb-size patches of heart tissue that contain up to 50 million human stem cells. The stem cells are programmed to turn into working heart muscle that can be seen "beating" spontaneously after three days, and which can mimic mature heart tissue within one month. One or more of these patches could be implanted onto the heart of someone after they've had a heart attack, to limit or even reverse the loss of the heart's pumping ability. A recent study (presented at the British Cardiovascular Society Conference) shows that the patches were safe when used in rabbits, and led to an improvement in heart function without causing abnormal rhythms, which is a potential side effect of other stem cell delivery methods. The patches also appeared to be nourished by blood vessels growing into them from the recipient heart. The results of this study will be used to design clinical trials, to see whether similar levels of heart repair can be achieved in humans.

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Canada's
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of **STEM**

10 WOMEN WHO BROKE BARRIERS
& MADE HER-STORY

■ BY JANA MANOLAKOS

10 leading ladies



LAST SUMMER news came out that Donna Strickland became the third woman in history to win a Nobel Prize in Physics – among them, the only Canadian. A lone figure in the blinding glare of the world’s media, she stood for all trailblazing women of science – past, present and future.

We wanted to take a closer look at some of the game-changing Canadian women in STEM, so here are 10 that everyone should know well.

Reaching for the stars: Roberta Bondar

1 The first Canadian female astronaut, as well as a physician, scientist and photographer, Roberta Bondar was aboard the Space Shuttle Discovery for its January 1992 mission, realizing a personal dream and capturing the imagination of millions. Upon her return, Bondar wrote *Touching the Earth*, a book in which she speaks of her space experience and her love of the planet.

For almost 20 years, Bondar has been on the scientific forefront in discovering how the brain adapts to unfamiliar environments. She headed an international team at NASA for over a decade that researched the connections between astronauts recovering from the microgravity of space and neurological illnesses here on Earth, such as stroke and Parkinson’s disease. Bondar’s techniques have been used in clinical studies at Harvard Medical School and the University of New Mexico.

Bondar also participated in the National Gallery of Canada’s landmark exhibition “Science and Photography: Beauty of Another Order,” and she photographed all of Canada’s national parks for *Passionate Vision: Discovering Canada’s National Parks*, published by Douglas & McIntyre. Her book *Canada: Landscape of Dreams* is now in its second printing.

Bondar now applies her insights and lessons learned from the unpredictable environment of space to today’s constantly changing business environment. She created HyperThink, a perspective and process that helps companies make adaptive decisions when entering uncharted territory.

Among her numerous distinctions, Bondar has been honoured as a Fellow of the Royal Society of Canada, inducted into the Canadian Medical Hall of Fame for her pioneering research in space medicine, named by TIME magazine as one of North America’s Best Explorers and recognized with the Order of Canada and the NASA Space Medal. In addition, she has received 24 honorary doctorates from Canadian and American universities. Dr. Roberta Bondar is truly a Renaissance woman.

A real “Goh” getter: Cynthia Goh

Cynthia Goh, founder of the Impact Centre at the University of Toronto (UoT), always loved science. It began in fifth grade, in a remote part of the Philippines, after reading a book on the universe. Since then, she’s made science her business – and a business out of science.

Although Goh is a physical chemist working in biomaterials, nanotechnology and biodiagnostics, she’s also a start-up champion, bringing scientific discoveries to market. At the Impact Centre, which she officially established in 2013 with a mission to bring science to society, she leads a team of researchers and advisors working to transform ideas into products and services.

Her expertise in scientific entrepreneurship has been sought after by participants in her training programs, like Entrepreneurship101 (E101) and Techno. E101 became the flagship training program at Toronto’s MaRS Discovery District and is offered online to over 10,000 individuals annually. Techno has led to the creation of over 160 start-ups and collectively, Techno start-ups have received funds in excess of \$80M from public and private sources.

Together with her students, Goh founded seven companies, beginning in 2001 with Axela Biosensors Inc., which produces a commercial instrument used by researchers and clinicians for a variety of applications in the bio and medical areas. Other companies include Vive Crop Protection, which offers an eco-friendly pesticide delivery system to Canadian and U.S. markets; Pueblo Science, a not-for-profit that develops hands-on training for teachers in low-resource communities worldwide, reaching over 10,000 teachers in eight countries; Sciventions, a nanomaterial e-commerce platform; and Phantin, an environmental coatings company which was introduced in 2015 with sales in China.

When Goh isn’t in a business suit pushing commercialization of the next start-up, she’s in a lab coat at UoT. Goh has developed numerous technologies and more than 75 patents, for which she was awarded UoT Inventor of the Year in 2014.

A golden opportunity: Anna Goldenberg

Anna Goldenberg is breaking ground in her new role at Toronto’s Hospital for Sick Children as its inaugural chair in biomedical informatics and artificial intelligence – the first post of its kind to exist in a Canadian children’s hospital.

“I feel like right now as a computer scientist, as a researcher in machine learning and AI, I can actually make a big difference in health care,” Goldenberg told *The Globe and Mail*. “It will take time, but I think we are getting closer and closer to seeing it happen.”

Goldenberg’s research centres on how machine learning can be used to map human disease heterogeneity. At SickKids, where she already works as a senior scientist, she has two trillion data points to work with, collected from the hospital’s 42 intensive-care beds. Her current research at SickKids

uses patient data and AI to predict cardiac arrest before the heart stops beating – a model the hospital is testing to serve as an early warning system for its young patients. The position is being funded in part by a \$1.75 million donation from Toronto entrepreneur Amar Varma, whose son underwent surgery at SickKids six years ago.

Goldenberg is an expert in developing machine learning approaches for biological data, network methods and most recently, data integration of omics and clinical data. The current focus of her lab is on developing methods that capture heterogeneity and identify disease mechanisms in complex human diseases. Her translational focus is on methods that efficiently combine many types of patient measurements to refine diagnosis, improve prognosis and personalize drug response prediction for patients with complex human diseases.

Doing the neutron dance: Victoria Kaspi

In 2016, Victoria Kaspi, a McGill University astrophysicist, became the first woman to win Canada’s top science prize, the Gerhard Herzberg Canada Gold Medal from the Natural Sciences and Engineering Research Council of Canada (NSERC). Kaspi accepted the award on behalf of her research group, a team responsible for several major discoveries in the field of astrophysics.

Fascinated by the night sky and the mysteries of the universe since childhood, Kaspi is described by NSERC as one of the world’s leading experts on neutron stars, the ancient remnants of the most massive stars in the Milky Way.

“Part of understanding the formation of neutron stars is understanding the origin of all matter,” she says in an NSERC video. Neutron stars offer this opportunity because of their extreme gravitational and magnetic forces; they can be as small as several kilometres across, but more massive than the Sun. “If you take a teaspoon full of a neutron star, it weighs a billion tonnes,” Kaspi explains. “This is not like matter we’re familiar with here on Earth. And yet it is a form of matter that can exist in the universe, and we’re trying to understand the nature of that matter.”

Among Kaspi’s achievements, she discovered a pulsar that rotates at 716 times per second, the fastest speed to date. Her team’s 2002 landmark discovery of powerful X-ray bursts from an enigmatic class of star essentially doubled the number of known magnetars in our galaxy. Using observations of a binary pulsar – two pulsars orbiting each other – she deployed a new test to validate Albert Einstein’s general theory of relativity. In 2013, Kaspi published her discovery of a second magnetar in our galaxy – a rare type of star with a colossal magnetic field and strange behaviour.

Kaspi’s study of neutron stars also earned her the NSERC John C. Polanyi Award, which honours an individual or team whose Canadian-based research has led to outstanding advances in the natural sciences or engineering.

Pioneer, war hero and role model: Elizabeth (Elsie) MacGill

Last year, the Bank of Canada released a new \$10 bill, making history by featuring a woman: social justice defender Viola Desmond. It was a good choice, but cannot have been easy to make because among the list of iconic Canadian women was another contender, Elsie MacGill. Born in 1905, she was the first practicing female engineer in Canada and the world's first female aircraft designer; she was also a Canadian war hero, as the only woman to lead a major wartime production plant. In 1938, she became the chief aeronautical engineer for Canadian Car & Foundry (CanCar) in Fort William, where she retooled the plant for mass production of the Hawker Hurricane fighter planes during World War II – a role that won her the nickname “Queen of the Hurricanes,” and in no small way helped the Allies win the war. The plane was one of the main fighters in the Battle of Britain. At the time, 60 percent of air victories by the Royal Air Force involved this single-seat fighter aircraft. At CanCar, MacGill also designed, built and tested the Maple Leaf II Trainer. She re-engineered the plane, based on a previous model, and brought it to aerial testing. It never went into full production in Canada, but is recognized as the first aircraft designed and built by a woman. Ironically, this Canadian strongwoman needed a cane to help her maneuver through the assembly lines, having lost her mobility to polio after graduating from university.

An active Canadian feminist, MacGill served two years as national president of the Canadian Federation of Business and Professional Women's Clubs and was a member of the Royal Commission on the Status of Women in Canada in the late 1960s. Her articles on aviation appeared in many publications, even those with female audiences, like *Chatelaine* and *Vogue*. She was pivotal to building diversity in the Canadian engineering profession, and planted the roots for initiatives that encourage women to pursue engineering. Ninety years later, according to Engineers Canada, women continue to be significantly underrepresented in the engineering profession, where less than 13 percent of practicing licensed engineers are female.

Engineering phenom: Veena Rawat

It was at her convocation ceremony in 1973 that Veena Rawat heard herself described as the first woman to receive a PhD from the Department of Electrical Engineering at Queen's University. It was a “first” she had seen before, having been the only woman in her undergraduate class at the University of Rajasthan in India, and again when working on her Master's degree. Several “firsts” followed.

Promoting Canadian innovation and working with international partners has been an important part of Rawat's work. In 2003, she became the first woman to chair the United Nations' International

Telecommunications Union (ITU) World Radio Conference. In this role, she worked with 192 delegates on formal resolutions to bind all nations on allocations of channels for various communications. For her successful leadership of the conference, Rawat received a gold medal from the Secretary-General of the ITU.

After 2003, Rawat joined the Communications Research Centre (CRC), an agency of Industry Canada, becoming its first female president a year later. Under her leadership, the CRC extended broadband services to remote and rural areas, improved search and rescue satellite-aided tracking, and developed the world's first WiFi-based cognitive radio-development platform.

Rawat's doctoral research at Queen's University was on creating optimal communications in remote locations, testing cables to see how they transmitted radio signals in underground mines and tunnels. It was research she completed despite being barred from entering an active mine because she was a woman, relying on male colleagues to collect the data on location for her. The research completed, Rawat successfully defended her thesis, “Unorthodox transmission lines for continuous access guided communications.”

After retiring from a 36-year career in federal public service, which included six years as president of the Communications Research Centre, Canada's centre of excellence for telecommunications, Rawat was hired by RIM as Vice-President, Advanced Technology Team. She also serves as RIM's Ambassador to the International Telecommunication Union (ITU), an agency of the United Nations.

These days, the wireless communications expert does her best to mentor and inspire both women and men in the field she loves, urging engineering students to take a global view of the job market.

Statistical powerhouse: Nancy Margaret Reid

Nancy Margaret Reid, professor of statistics at the University of Toronto, is challenging the odds for women in STEM. “One of my probability professors once stated in class that, ‘Women are not suited for mathematics.’ We've come a long way since then, but we still have a relatively small number of women in leadership positions,” she says, adding that change needs to happen or Canada will miss out on a lot of talent.

Reid explores the boundary between theoretical statistics and real-world applications. She teaches both advanced statistical theory to graduate students and a course on “Lies, Damned Lies and Statistics” to first-year classes.

Reid was the first woman to receive the prestigious international Presidents' Award from the Committee of Presidents of Statistical Societies, and she was President of the Institute of Mathematical Statistics (1997). She believes that “statistics is a great way to apply mathematics to a wide variety of areas of science and social science – problems in cancer treatment, climate modelling, educational testing, and many other fields. Finding the common thread in these problems is the challenge of theoretical statistics.”

Last spring, The Royal Society announced that Reid was one of 50 U.K. and commonwealth scientists selected to become the society's newest fellows. She shares this year's honour with some of the world's most eminent researchers and innovators.

Over her career, Reid has been an important contributor to the field of theoretical statistics, especially in the area of statistical inference – making sense of large and complex sets of data. “Whether you are studying health or air pollution or you're discovering new planets, almost every scientist uses statistical analysis in one way or another,” says Reid. “A theoretical statistician like me basically studies an abstract version of a problem. I try to find the common threads between different research areas in order to make statistical methods more accurate and efficient, so that scientists across disciplines can extract the best possible information from data sets.”

Over the years, recognizing and supporting women in STEM fields has increasingly become a priority for her, Reid says. To draw attention to gender barriers and inequality in her field, Reid wrote an essay in 2014 titled “The Whole Women Thing,” examining cognitive biases that impact the advancement of women in statistical science.

Helping invent the future: Molly Shoichet

By becoming Ontario's first chief scientist in 2017, Molly Shoichet hoped to grow public trust in science and help the government make better-informed decisions based on evidence. The award-winning biomedical engineer aimed to build Ontario's reputation for innovation. Half a year later and just days after the new progressive conservative government was sworn in, the position was cancelled.

Shoichet holds the Canada Research Chair in Tissue Engineering at the University of Toronto and, among numerous awards, received the Order of Canada in 2018 and the Killam Prize for Engineering in 2017 for her work on tissue and polymer engineering, focusing on targeted drug delivery, tissue regeneration and stem cell research. Shoichet is a strong advocate of women in science and technology, a career she decided to pursue because, she says, “I got really excited about this idea of inventing the future, coming up with strategies that would make a difference in people's lives, instead of applying what we already know.”

To expose the public to science, she cofounded Research2Reality, which produces short, accessible videos showcasing scientists' work, and airs them on social media and at public events. Shoichet also helped organize an exhibit of images from research laboratories featuring everything from biological cells to lakes and oceans, called “Inner Spaces,” at the Ontario Science Centre last May.

Steering MaRS: Ilse Treurnicht

Ilse Treurnicht became the first CEO of Toronto's MaRS Discovery District in 2005, assuming the helm of what grew to become a world-renowned innovation hub under her leadership. The centre has since doubled in size and is now home to some 6,000 people from 150 organizations, which collectively raised over \$3.5 billion for business development in areas that include health, cleantech and fintech.

The key to MaRS's success has been Treurnicht's commitment to building a dynamic, collaborative atmosphere that brings together educators, researchers, entrepreneurs and business types in a single space, allowing innovative ideas to converge. Here, specialized infrastructure as well as access to critical talent, capital and customer networks helps innovators and entrepreneurs build high-impact growth businesses.

Before joining MaRS, she was CEO of Primaxis Technology Ventures, and was an entrepreneur and executive in several emerging technology companies. Treurnicht was Chair of the Canadian Task Force on Social Finance in 2010, served on the Government of Canada's Science, Technology and Innovation Council (STIC), and is a member of the Advisory Council on Economic Growth. She chairs the board of Triphase Accelerator Corporation, a cancer drug development firm, and serves on the boards of Cogniciti, a brain health company, and Canada's Public Policy Forum. Treurnicht retired from MaRS in 2017.

First female Nobel laureate: Donna Strickland

Last year Donna Strickland became the first Canadian woman to receive the Nobel Prize in Physics for developing chirped pulse amplification (CPA), a prize she shared with her PhD supervisor Gérard Mourou. They published their research in 1985 when Strickland was a PhD student at the University of Rochester in New York State. The work paved the way for the most intense laser pulses ever created, opening the door to what has become routine laser eye surgery today as well as laser-based cameras that are now used in laboratories around the world to create ultra-slow-motion movies of chemical and physical reactions.

Strickland and Mourou developed a solution that resolved the problem of amplifying beams without damaging the laser amplifier in the process. They realized that by stretching, amplifying and then compressing the beams, they could boost the intensity of the light dramatically. This allowed more light to be packed into a shorter time, increasing the intensity of the pulse, while allowing laser beams to cut into matter with extreme precision. The technique allowed lasers to become more useful to scientific, industrial, medical, energy, military and security communities.

Before earning her PhD, Strickland completed a bachelor of engineering degree at McMaster University. From 1988 to 1991, she was a research associate at the National Research Council Canada, where Strickland worked on ultrafast phenomena. After a stint as a physicist at Lawrence Livermore National Laboratory, she joined Princeton University's Advanced Technology Center for Photonics and Optoelectronic Materials. In 1997, Strickland became the second female professor of physics at the University of Waterloo, where her ultrafast laser group develops high-intensity laser systems for nonlinear optics investigations. In 2013, Strickland served as the president of the Optical Society (OSA) and is an OSA Fellow. She is also a recipient of a Sloan Research Fellowship, a Premier's Research Excellence Award and a Cottrell Scholar Award. **BL**

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OURS, A TEAM.



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2018 KILLAM RESEARCH FELLOWSHIP WINNER

A portrait of Hanadi Sleiman, a woman with long, dark, wavy hair, smiling. She is wearing a black blazer over a blue top and a necklace with small charms. The background of the portrait is white with faint blue and pink molecular structures.

HANADI SLEIMAN

■ BY JANA MANOLAKOS

Over the past three decades, bio-molecular chemists, boosted by nanotechnology, have found mind-boggling solutions in the fight against cancer. On this global battlefield, a research team led by McGill chemistry professor Hanadi Sleiman manipulated DNA molecules to create nanostructures that, like infinitesimally small heat-seeking missiles, could selectively target and deliver cancer-killing drugs to the affected cells of an aggressive form of the disease, known as triple-negative breast cancer. This is science-fiction come to life, and it's what won Sleiman a 2018 Killam Research Fellowship. We spoke with her to learn more about her fantastic voyage.

Q + A

When did you first discover a love for science and chemistry?

I am in awe of what nature can do and how nature can assemble things. By observing and asking questions, nature can teach us to reach a new level of complexity in our work. While my first love was chemistry, when I became a professor, I started falling for biology, and now I'm captivated by the combination of the two. This exotic field that I'm in, that started out with just making beautiful molecules, is a very powerful field for medicine and for solving problems, not only in medicine with drugs, but also medicine in terms of prevention and diagnosis. I can't disclose the collaborations that we have with companies, but we're doing both fundamental and applied research, and it's fascinating to see that these crazy structures are now very useful in those ways. So I guess I would say that we are used to small molecules, but now we have DNA structures that can be very powerful.

Who inspired you?

When I was doing my PhD at Stanford, it was in inorganic chemistry and catalysis, a completely different field than DNA. Jean-Marie Lehn, who had just won the Nobel Prize in Chemistry, came to Stanford to give a talk about his research. He opened my eyes to this amazing field that he called supramolecular chemistry. Prof. Lehn was exploring ways to assemble molecules into bigger structures with complex functions in the way that nature does. That sparked my imagination, and he became my postdoctoral advisor. When I started my independent program at McGill, I thought that it would be great to bring DNA as a building block into the field of supramolecular chemistry, for the assembly of structures. At the time, there was just really one person that was the most active in the field; in fact, the person who pioneered the field, Nadrian Seeman, at New York University. He's the one who really invented manipulating DNA, and was also an inspiration for my research.

Is it fair to say that science has reinvented the DNA molecule?

Thirty years ago, we saw DNA as a fantastic molecule for storing and processing genetic information. Today, we recognize that DNA is much more than that. Nature has evolved it to be very specific and selective because it needs high fidelity to store information. What that also means is that the structure of the molecule is very unique and special. People in the field realized that we can use DNA like a Lego block. It's exciting, because you have to understand how this molecule assembles, and then

twist and turn it to change it into what you want it to do, which was never really there in the first place. In determining what we can make with DNA, as scientists we are only limited by the extent of our imagination.

We've come a long way since first recognizing the power of nanotechnology. How did nanotubes play into your discovery?

I started as a professor in the late 1990s, when nano-science had just begun to explode. We were learning that many things occur on a scale that was very different from the macro scale or even from small molecules we had been studying. And of course, DNA assembles and performs its functions at the nano-scale; it was a confluence of two fields, biology and nanotechnology. At the Sleiman Lab, my research group and I use DNA as a building block, making short pieces of DNA using a DNA synthesizer. We use these short pieces of DNA to make minuscule "cages" or nanotubes, three-dimensional geometric structures like a cube or a tube.

How did you apply these nanotube "cages" to therapeutic drugs for breast cancer?

Nanotube cages allow you to store therapeutic drugs within them. With specific stimulus you can open the "cage" to release the drug. That's a very unique thing about DNA; you can make it respond to stimuli in a very precise way, and this triggered our imagination. Say, for example, a cancerous cell has a specific molecule that's not present in normal cells. We recognized you could design a DNA cage that stays closed except when it encounters this particular molecule, enabling the release of therapeutic drugs only within the tumour environment.

There's a lot of work coming out of the Sleiman Lab. What is the work that you're most proud of?

When I started, there were just two or three 3D structures out there, and no general process for making them in a well-defined way. There was one tetrahedron that everybody made.

One in two Canadians develops cancer in their lifetime, and one in four will die from this disease.

About 10-20 percent of breast cancers are triple-negative breast cancers, where affected cells do not respond to standard hormone therapy, resulting in a poorer outcome.

Our dream was to find new ways to make them, to create a library of them and start to control them. Back then, people didn't know how to put things inside the structures, nor how to selectively take them out. We showed that we could actually put guest molecules inside our cages, and with very specific stimuli, kick them out, which opened the door for biological applications.

Have you seen changes in the number of women entering the fields of STEM?

More women are entering, and we are able to retain them, especially in Canada, particularly in Quebec where our daycare system is so well organized. But still, it's frustrating to see women entering the chemistry field and then leaving at the end of the day because they are seeking more gregarious environments. Being in the lab and doing science at the bench is often done alone. Personally, I also feel there's a tendency for some women to feel less confident in their abilities than men, despite equal accomplishments.

The Killam Fellowship gives you \$70,000 annually for the next two years to optimize these drug-delivery vehicles. But that's just a drop in the bucket. What needs to happen to support discovery in Canada?

The NSERC Discovery Grants, based on academic and research excellence, are probably one of the best mechanisms I've seen in North America. Canada really should emphasize more fundamental research in its funding schemes, and excellence rather than just quick fixes. We're not asking for more money. We're just asking for a better place to put that money, and this government has been listening.

Commercialization can take another 10 or 15 years. What comes next for you?

If you want to commercialize something like a drug, something that's going to be used in the body, you're absolutely right, it will take that long. My aim is to discover and validate through trials, molecules and structures that offer new tools to the field to support big advances in drug discovery. There's now a class of drugs that are called biologic drugs that have started to revolutionize medicine. What we're hoping to do with our work is to actually facilitate the implementation of these new kinds of drugs. But whether I'm going to discover a drug that is going to be commercialized, I really don't know. Pharmaceutical companies have so many of these molecules in the pipeline, and a tiny percentage of these molecules actually make it.

Your students have commented about how you have inspired them, how knowledgeable and caring you are, but also what a wonderful sense of humour you bring to your classes. How do you introduce humour to a very complex subject?

I don't tell jokes or anything, but we all have these really nerdy, geeky quirks that make students laugh, and I don't mind; whatever it takes for the student to engage. If I'm dancing in class to illustrate some kind of concept, which I do, and if I look totally ridiculous, that's fine. I don't mind, it's good. Teaching students is the most rewarding thing that I've ever done in my life. **BL**



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Ag-West Bio is funded by the Saskatchewan Ministry of Agriculture and Agriculture & Agri-Food Canada.

THE OCEAN FRONTIER INSTITUTE
STUDIES THE ATLANTIC OCEAN FOR
CLUES INTO CLIMATE CHANGE

PLUMBING the Depths

■ BY JANA MANOLAKOS

By the time you finish reading this sentence, you will have taken another breath, gifted to you by Earth's oceans.



Critical to life on the planet, the oceans produce over half of the world's oxygen, while absorbing a third of human-produced carbon dioxide; but, our oceans are under tremendous stress, experiencing a potentially catastrophic decline brought on by climate change, pollution and the planet's growing population.

One of the organizations working to understand and analyze this situation is the Ocean Frontier Institute (OFI), a partnership between Dalhousie, Memorial and Prince Edward Island (UPEI) universities, which opened its doors three years ago with an investment of \$227 million from the Government of Canada and various private and public-sector organizations. Driven by a multi-year strategy for research, collaboration and capacity-building, OFI defines itself as an “interdisciplinary transnational hub” that connects marine researchers on both sides of the North Atlantic, in a collective effort to keep the ocean safe and support development of Canada's sustainable “blue” economy.

Wendy Watson-Wright, the institute's first CEO, has seen a growing wave of global recognition that things must change. A trail-blazing champion of the deep, Watson-Wright previously worked for Fisheries and Oceans Canada and the Intergovernmental Oceanographic Commission of UNESCO.

“The whole energy around the ocean, globally and in Canada, has burgeoned in the last couple of years, but it's taken a long time,” she says, while pointing out that the Canadian government has been supportive with initiatives like the Ocean Protection Program, the Atlantic Fisheries Fund and the Ocean Supercluster.

“We all need to recognize that it's because of the ocean that we can all live on this planet. And whether you live inland or on the coast, what happens to the ocean will affect all of us,” says Watson-Wright. “OFI is trying to contribute to learning more and to coming up with solutions to the issues that are facing the ocean and coasts.”

Two years ago, the institute rolled out its first phase of research funding, with 16 large projects (expected to conclude by 2022) that include scientific analysis of the changing ocean ecosystems, as well as studies to strengthen marine safety, ocean data and technology and the fishing and aquaculture industries. Earlier this year, OFI issued a call for submissions to its next phase of large research projects (starting later this year, and concluding in 2023); it plans to invest \$16 million into consortia that will focus on ocean climate change and the impact to North Atlantic coastal communities.

Dr. Wendy Watson-Wright (top), Dr. Anya Waite.

Photo credits: OFI.

Sitting on OFI's predominantly female executive team is Scientific Director Anya Waite, who explains that in this new phase, "We are trying to get natural scientists to work with social scientists, and also link in with engineers and physicists, so we can start to transfer some of the exciting ideas that scientists have for commercialization and the innovation landscape." The institute's mandate is one that Waite believes is universally relevant: "We're barely catching up with where we need to be in terms of trying to mitigate climate change and impacts we have on diversity and other life on Earth. If we tackle climate change, fossil fuels and carbon dioxide accumulation in the atmosphere, we will have won. But getting there is a massive act." She hopes these efforts will not be distracted by other global issues.

On March 25, Canada's Fisheries and Oceans department named another 32 aquatic species to be added or reclassified under its Species at Risk Act. Currently, there are 225 species identified by the act as at risk in Canadian waters.

"Our job is to paint the details on how climate change is happening, and how ecosystems and organisms are responding to the changes that have already been experienced," Waite explains, "and to mitigate loss of biodiversity with wise management and good advice on policy." Among these efforts, a group of researchers is working with government policy makers to "future proof" Marine Protected Area networks so they continue to preserve biodiversity. And in Labrador, OFI is working with the Nunatsiavut Government to help devise ecosystem indicators in order to better manage the resources around their coastlines.

Data sharing is another exciting area for OFI, especially how big dataflows impact communities. "It's just exploding now," says Waite. "It's an innovation landscape in Atlantic Canada, with the Creative Destruction Lab and organizations like Mitacs and Springboard Atlantic, bringing entrepreneurs and ideas into the forefront to see what can be commercialized that could potentially bring new industries and new ideas to Atlantic Canada." OFI also has relationships with the Centre for Ocean Ventures and Entrepreneurship (COVE), as well as the Ocean Supercluster, exploring how research and business work together.

Emerging new technologies are making this an exciting time for OFI and its research facilities. There's an array of tools for every facet of ocean study. "We will hopefully be able to share and integrate the use of various instruments," Waite says. "We have chemical analyzers of all sorts. We have underwater imaging facilities, underwater gliders and ROVs [remotely operated vehicles]. Our aim is to bring together existing infrastructure and calibrate it to international standards, so that everyone can find it, use it and support it."

Waite points to the work of a team under Dalhousie's Jon Grant, who along with industry partners are using tiny sensors on mussels to monitor when they close their shells in response to toxins in the water – information that's vital to fish farms. OFI researchers are also finding

In the next 10 years, aquaculture is expected to exceed wild fisheries in global seafood production. Producing nutritious feed for farmed fish is costly and impacts environmental and economic sustainability.

The oceans absorb **50 times** more carbon dioxide than our atmosphere and cover **17%** of earth's surface, regulating climate and weather patterns.



TRAILBLAZING IS IN THEIR DNA

Before being appointed the OFI's first CEO in 2016, Dr. Watson-Wright was the first female Executive Secretary and Assistant Director General for UNESCO's Intergovernmental Oceanographic Commission, the first female Assistant Deputy Minister of Science for Canada's Department of Fisheries and Oceans, and the first female Director of the St. Andrews Biological Station in Saint Andrews, New Brunswick, a facility with its beginnings in 1898.

Dr. Anya Waite is OFI's Scientific Director and Assoc. Vice-President, Research (Ocean), at Dalhousie University. Previously she was Section Head of Polar Biological Oceanography at the Alfred Wegener Institute in Bremerhaven and Professor of Oceanography in the Department of Biology at the University of Bremen. Dr. Waite worked on the first Southern Ocean iron fertilization experiment, and in the East Indian Ocean exploring the dynamics of mesoscale eddies, the nitrogen cycle in oligotrophic systems and the biology of the spiny lobster larvae in Australian waters.

new ways of transmitting data underwater through sound and are working on novel means to measure the concentration of carbon and nutrients using microphytic cells on moorings deep in the water. Better ocean images are being delivered by new types of sensors for Argo Floats – self-propelled robots that descend to 2,000 metres and share information by satellite.

“We are seeing animal migrations we didn’t know existed,” Waite explains. “For example, we didn’t know the eel, a critically endangered species in Canada, could go down 700 metres. There are different types of cameras taking images from the smallest plankton in a litre of water to life on the sea floor at depths of 6,000 metres.” All the information that’s generated – genetic data, sensor data, satellite data – requires significant computational power. “It means that we need to train a whole new generation of people who know how to mine these massive data streams,” says Waite.

“There are many fronts we are working on with data,” Watson-Wright adds. OFI relies on a network of committees and data specialists to build and maintain powerful information systems needed to harness the data streams. The institute recently entered into a new partnership aimed at helping industry and academia solve big analytical problems in the ocean. “IBM, one of our industry partners, has provided a platform called DeepSense to allow analytics, machine learning and all those kinds of capabilities that enable OFI researchers to gain more information from their ocean data,” says Watson-Wright.

OFI also recently received government funding for the Canadian Integrated Ocean Observing System, a new monitoring network that covers a previously overlooked part of the Atlantic as part of the Global Ocean Observing System; closing this gap is something Watson-Wright says is long overdue. The institute also recently opened a number of new laboratory facilities within Dalhousie’s Steele Ocean Sciences Building.

“One very important aspect of what we do is knowledge mobilization that includes commercialization, but it also includes outreach and ocean literacy,” Watson-Wright says, pointing to OFI’s Ocean School, a partnership with Dalhousie and the National Film Board of Canada to develop a web-based curriculum for grades six to nine, available around the world. **BL**

Sustaining aquaculture

As Stefanie Colombo descends into the depths of the ocean, the only audible sound comes from her rhythmic breathing, transformed into streams of shimmering bubbles by her diving apparatus. A divemaster, Colombo is Canada Research Chair in Aquaculture Nutrition and Assistant Professor at Dalhousie University. To her, the ocean “feels like a second home,” which she has sought to protect since her first time snorkeling at age six with her parents in Hawaii.

Colombo leads one leg of a five-part scientific study where researchers, funded in part by OFI and NSERC, are working with industry partners to improve aquaculture practices and examine fish health and resiliency. Her expertise lies in nutrition and production, making sure that fish grown for human consumption are healthy, grow fast and produce quality nutrition, without depleting the ocean. Colombo believes there is a tremendous need to improve sustainability and conserve the ocean’s food web by reducing the amount of wild fish used in feeds for carnivorous species like salmon. Her particular interest is in fatty acids, like omega-3s, for optimal fish health.

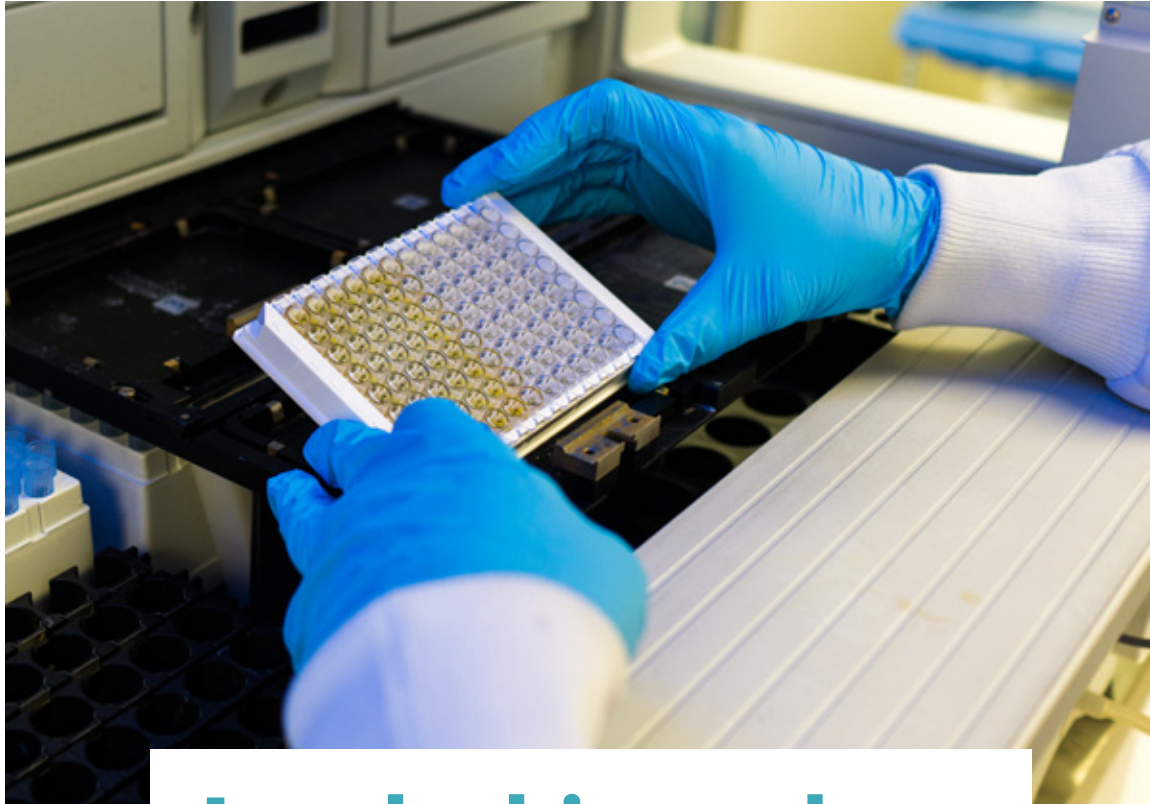
Nestled on the south side of the Salmon River floodplain, close to the river’s mouth, the town of Truro, Nova Scotia, is a provincial hub and home to Dalhousie’s Aquaculture Centre. Here, Colombo performs the bulk of her research, amid giant fish tanks teeming with salmon at all life stages, microscopes for studying cellular structures like those in intestinal tissues and freezers filled with biopsies. Modern mechanical systems, allow for precise environmental control for a wide variety of species, from cold-water marine fish and shellfish to tropical freshwater fish. A teaching lab, dry lab, two wet labs, algal production lab and aquatic rearing facilities are housed in 1,800 sq.ft. of space.

It’s a versatile finfish system and feed production facility that enables experiments with all kinds of marine and freshwater species, in a range of water temperatures. Right now, Colombo is working on diets for Atlantic salmon that will help the industry reduce its reliance on fish meal and oil. “We are looking at micro-algae as a source of protein and fat for salmon,” she says, explaining that they are testing two products. “One is a meal, so it’s protein and fat – it’s basically freeze-dried micro-algae – and the other is oil.” These are included in the fish diets in different ratios to pinpoint the ideal mix of ingredients. At the facility’s feed mill, an extruder and steam pelletter prepare the experimental diets. “It’s pretty unique to have the aquaculture facility and the feed mill together on one campus,” Colombo notes.

When she’s not in the lab working with her students, Colombo teaches a class on fish nutrition at Dalhousie’s Haley Institute of Animal Science and Aquaculture. And then there are the new projects, manuscripts and grants – work that she often does in collaboration with her mentors and research colleagues, Matthew Rise of Newfoundland’s Memorial University (MUN), Chris Parrish (MUN), and Dalhousie’s Jim Duston. A typical two-year project for Colombo costs about \$200,000 for all of the analyses, student stipends and material for rearing fish. As she’s about to open her sixth study, those numbers can add up, so funding from OFI, NSERC and other grant sources is vital.



In 2015, Stefanie Colombo made headlines with her PhD research, which found camelina oil was an effective crop-based alternative for feeding farmed fish. Colombo explored the connection between fish oil and camelina oil in a \$6.1-million project supported by Genome Atlantic, the Atlantic Canada Opportunity Agency and the Atlantic Innovation Fund. The results found that camelina was the best match to the type of fatty acid that’s ideal in fish feed. In 2017, the extracted oil was approved by the Canadian Food Inspection Agency for farmed salmon and trout, a commercialization success story. Photo credit: Nick Pearce.



Let the biomarkers do the talking

Augurex built its business on a novel discovery that detects rheumatoid arthritis

■ BY MITCHELL BROWN

It began, as many brilliant ideas do, with a sandwich. Walter Maksymowych and Aziz Ghahary were two scientists who struck up a conversation one day while waiting in a cafeteria line for their food. Discussing mutual areas of interest, they started trading thoughts about the similarities between skin wounds in burn patients and joint destruction in arthritis. It occurred to Maksymowych that a “sibling” of a protein in Ghahary’s research could play a role in rheumatoid arthritis (RA). Based on that conversation, they examined the joint fluid of patients with arthritis and found a unique and previously unexamined protein. It occurs naturally and is harmless inside of cells, but when the protein is pushed outside of cells (as happens in patients with RA), it triggers a cascade of autoimmune reactions that cause inflammation and joint destruction.

Ten years later, the discovery of the apparent role of protein 14-3-3 η (the Greek symbol η , pronounced eta) in rheumatoid arthritis yielded a test, in commercial production by Vancouver-based Augurex, that detects rheumatoid arthritis earlier and assists with prognosis to guide clinical management. The main benefit of the test is that the proteins and antibodies normally used to diagnose rheumatoid arthritis may be absent in about one-third of patients, limiting the effectiveness of the most widely used methods for early detection – which meant many people would experience joint damage before a proper diagnosis was made. But the JOINTstat test offered by Augurex helps close that gap by looking for that previously unknown marker for the disease.

Augurex co-founders Anthony Marotta and Norma Biln

Access to early treatment with appropriate drugs could prevent 178,000 cases of severe rheumatoid arthritis over the next 30 years, which could alleviate \$33.7 billion in lost productivity and \$5.1 billion in direct health care costs.

formed Augurex in 2006 to identify and develop early-stage discoveries in the biomarker space. The company licensed the discovery from the University of B.C. after meetings with Ghahary, Maksymowych and co-inventor Ruhangiz Kilani, who continued to play a key role in the early stages of the test's development.

Today, the privately held Vancouver-based company is one of B.C.'s biotechnology success stories. Little wonder why: According to the Arthritis Alliance of Canada, more than 233,000 Canadians live with a moderate to severe disability because of RA, with 50,000 of them having significant difficulty or no capacity to wash or dress themselves without help. Access to early treatment with appropriate drugs could prevent 178,000 cases of severe rheumatoid arthritis over the next 30 years, which could alleviate \$33.7 billion in lost productivity and \$5.1 billion in direct health care costs.

"When you think about our healthcare system, there aren't that many rheumatologists, and a lot of the time their referrals are patients who might not even have rheumatoid arthritis," Biln explains. "If there's no sense of which patients are more urgent, then everyone has to wait. With these tests, when patients are positive [for RA] you can get them into treatment within six to 12 weeks of symptom onset, which improves their clinical outcome."

Helping others heal runs in Biln's family, who emigrated to Canada from Syria when she was a baby. With her X-ray technician father and a nurse for a mother as her inspiration, she volunteered as a candy-striper in her teens and earned a B.Sc. in physiology and psychology before completing her MBA. A nine-month sales job for Pfizer in Vancouver turned into a longer commitment than she bargained for when she fell in love with both her future husband and the West Coast.

"Those nine months, it's been about 25 years now," she admits, laughing. "My kids are teenagers, so they really help you plant your roots."

Today, the first of Augurex's biomarker portfolio, the 14-3-3 η protein assay, is CE marked for European commercial sale, Health Canada approved as an IVD offered by LifeLabs Medical Laboratory Services and provided as a laboratory-developed test in the United States through Quest Diagnostics, LabCorp and RDL.

As for the future, Biln says the company is focused on supporting their commercial partners with more data to build the business; there's also a second product in the pipeline they plan to introduce in 2020. No matter what happens next for Augurex, Biln says the key to the company's success is collaboration, building on the example set by Maksymowych and Ghahary to work with their partners and with scientific and clinical researchers across different fields to find new ways to – as the Augurex motto puts it – "let the biomarkers do the talking."

"At the risk of sounding clichéd, it's about having the right people at the right times in the company's growth," she says. "When you're a start-up as we were 10 years ago, the type of talent you need is like a rocket booster, but when you're older in the business life cycle, you need different sets of skills. I think we've been very lucky to have the people we have, people who are engaged and excited to do what we do." **BL**



Co-founder Norma Biln

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Solving the PLASTIC PROBLEM



A Toronto-based startup, led by Luna Yu,
turns **food waste** into



biodegradable plastic

■ BY JANA MANOLAKOS

They say one person's trash is another's treasure. That's certainly true for environmental scientist Luna Yu, founder and CEO of Toronto-based Genecis Bioindustries Inc., whose team of scientists and engineers has found a way to change organic waste into biodegradable plastic, a process that has piqued the interest of investors. Sodexo-Campbell recently partnered with Genecis in a pilot project at its Campbell Soup facility in Toronto, which saw over 1,430 kg of organic waste diverted from landfills, while offsetting 1,210 kg of CO₂ emissions over six months. The bioplastic created from this food waste was enough to make 6,332 spoons.

According to a report released in 2017 by the Commission for Environmental Cooperation, the average Canadian throws out an estimated 170 kg of food each year, and most of it goes to landfills. For Yu, that "trash" translates into gold.



Luna Yu (left) and the Genecis team

The waste also releases methane into the atmosphere, a greenhouse gas emission that's a prime suspect in global warming.

"More than \$1 trillion worth of food is wasted globally every year. What we're able to do is to take this waste and turn it into something of higher value," says Yu. It's a solution that converts organic waste into a type of bioplastic called polyhydroxyalkanoate (PHA). PHA degrades within one year in both terrestrial and marine environments – while synthetic plastics can take hundreds of years to degrade in similar environments.

"Our goal is to create the highest value from organic waste," Yu explains, adding that the Genecis team has cultured hundreds of species of bacteria that currently don't exist in databases. "Soon we will be able to synthesize specialty chemicals and other premium materials from organic waste, all at a lower cost than traditional production methods, using synthetic biology."

Genecis uses a three-step process to create bacteria-forged polymers, or PHAs. First, a bacteria culture breaks down the food waste into platform molecules. These are then fed to a bacteria culture specialized at producing PHAs in their cells. Finally, a chemical extraction process breaks open the cells, then collects and purifies the plastic into granules.

The company's new 3,000-sq.ft. facility houses pilot-scale bioreactors that can complete the three-step process. Previously, Genecis had been supported by the University of Toronto–Scarborough to optimize the production process. When Genecis opens its demonstration plant with an industry partner next year, it will be able to convert three tonnes of organic waste into PHAs every week.

Genecis isn't the only company trying to make PHAs from waste, with companies in California and Sweden, but all are racing to achieve commercial scale-up.

Biodegradable plastic is already on the market, especially in the healthcare industry, made with sugar cane, corn and canola oil. It's a more expensive process, suggests Yu, who hopes to make bioplastics more affordable, reducing the cost of production by at least 40 percent through the use of food waste. The company website says, "We partner directly with waste companies, providing a destination for organic waste that is on par with landfill costs" – in effect, creating a revenue stream by using organic waste.

"More than
\$1 trillion

worth of food is wasted globally every year. What we're able to do is to take this waste and turn it into something of higher value."

Luna Yu, founder and CEO, Genecis Bioindustries Inc.

While PHAs can be used to make pretty much anything out of bioplastic, like packaging films, bags, containers and utensils, Yu says the types made by Genecis are best suited for higher-end, multi-use products like personal care products, flexible packaging, 3D-printing filament and medical applications, including surgical staples, sutures and stents.

Since launching in 2016, Genecis already has won more than \$700,000 in prize money from startup competitions. Recent ones include the BASF's first Innovation Pitch Series, a partnership with Toronto-based tech incubator MaRS. Genecis was also one of six finalists chosen by a panel of expert judges from across North American for the MaRS Women in Cleantech Challenge, sponsored by Natural Resources Canada. The winner of this competition will be announced by 2021.

In the meantime, Luna Yu is forging a path towards a better future. **BL**

PHA degrades within one year in both terrestrial and marine environments – while synthetic plastics can take hundreds of years to degrade in similar environments.

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SPRING 2019

Manjit Minhas

How her path to success started with family

+ Trending Now

The secret sauce of edible cannabis in Canada

WOMEN IN POWER

Food entrepreneurs, CEOs
and innovators

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Learning to be Leaders

By Dana McCauley

Only 19.5 percent of board members at Canada's top 500 companies are female. One rebalancing tactic popular with women's advocacy groups is to develop aspirational targets for female leadership representation in private and public organizations. While many programs report making modest progress toward these goals, why aren't big organizations able to tip the balance and elevate more women into leadership positions quickly?

While acute policy issues such as access to affordable, high-quality childcare need to be considered, less obvious issues are a factor as well. With 82 percent of Canadian women aged 25 to 54 employed, they are experienced participants in our workforce. And, although more women than men in the workforce have university credentials, even when the two genders have similar work experience, women are 60 percent less likely to move from middle management to executive teams. Clearly something significant is holding women back.

The problem is one of balance. According to a 2017 factsheet published by the Canadian Women's Foundation, 86 percent of women remember being taught to be nice to others growing up, but only 44 percent remember being taught to be a good leader, and a mere 34 percent recall being taught to share their point of view. In fact, three in four women state that they wish that they had been presented with more opportunities to learn how to lead. It seems to follow that as parents, teachers and bosses, we must reward girls and women for being leaders and critical thinkers more often.

Likewise, we should showcase successful female leaders as role models. In the highly competitive food manufacturing sector where I have the most experience, role models do exist. At Canadian branches of international corporations, women are landing prominent roles; Ana Dominguez was CEO of Campbell's Canada for three years, and Shelley Martin headed up Nestle Canada until she retired in 2018. While their careers are inspiring, as the stats above reveal, Dominguez and Martin are outliers. Where real progress is being made is at entrepreneurial food companies. Many women are creating corporate frameworks where they and other women can succeed without having to wait for established male leaders to invite them to join the management team. In many cases, these CEOs have risen to upper management in corporate roles but left to develop new concepts on their own.

Looking for inspiration? Here are just three of the many flourishing food companies led by women:

Good Food for Good: Founded and led by former marketing executive Richa Gupta, her company has gone from startup to national distribution in six short years by creating a line of parent-pleasing ketchups and sauces. As a Certified B Corp, Gupta's company meets rigorous standards of social and environmental performance.

Mother Raw: When investors purchased a fledgling raw food company, they knew they needed a strategic leader to transform a line of niche products into a powerhouse brand. Enter CEO Kristi Knowles, a former innovation executive at one of Canada's largest beer companies. From supply chain to name, Knowles reshaped the company into Mother Raw, which makes a nutrient-rich line of plant-based sauces and dips for their quickly growing North American customer base.

Switch Grocery: Accountant Neha Charnalia knew that attracting customers to an online grocery store specializing in keto and paleo-friendly food products was not going to be easy. To build awareness and loyalty, she invested heavily in creating and maintaining a community where members can learn from one another and find information from a trusted source. Just two years in, the result is a thriving business with thousands of ambassadors spreading the word.



Dana McCauley leads the New Venture Creation portfolio at the University of Guelph's Research Innovation Office. She is also the Innovation Expert for SIAL Canada.

Data source: www.canadianwomen.org/wp-content/uploads/2017/09/Facts-About-Women-and-Leadership.pdf



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News Bites

Eco-friendly, edible straws win the stage at Collision

This spring, Toronto hosted its first Collision Conference, North America's "fastest growing tech conference," attracting more than 25,000 international attendees, almost half of which were women. During PITCH, an on-stage competition between 60 startups (narrowed down from hundreds of applicants), a cleantech product of special interest to the food industry was selected as the winner: Loliware – a company formed in 2015 by industrial engineers Chelsea F. Briganti and Leigh Ann Tucker – produces an edible, seaweed-based straw that biodegrades in 60 days or less. The gluten-free, sugar-free and non-GMO bioplastic developed by Loliware was first used to create cups, but they were discontinued due to production challenges (such as breakage during shipping). After a successful Kickstarter campaign and an appearance on *Dragon's Den* that secured a \$600,000 investment, Loliware started shipping straws to its first customers this March. Several Fortune 500 companies are partnering with the company, including Marriott, Pernod Ricard and others to be announced later this year. "The plastics problem is quite literally as deep and wide as our oceans," says

Briganti, "so we feel an relenting sense of urgency to ensure we achieve huge impact through rapid adoption at massive volume." It appears that Loliware is well on its way.



Comet Bio 'upcycled' ingredients win at World Food Innovation Awards

By processing agricultural leftovers into high-quality, sustainable ingredients, Comet Bio is set to transform the food industry. The Ontario-based company won this year's award for "Best Ingredient Innovation" for its Arabinoxylan prebiotic dietary fibre extract and Sweeterra syrup, which is a healthier alternative to corn syrup. According to an independent Lifecycle Carbon Emissions Assessment (LCEA), Comet's ingredients reduce greenhouse gases by up to 60 percent compared to traditional corn syrup.

Chinova's mushroom fibre set to disrupt food and beverage industry as alternative to synthetic preservatives

A lowly mushroom is taking on the long-established synthetic food preservatives industry thanks to the work of Dr. Tanzina Huq, who won the Mitacs Outstanding Entrepreneur Award this past May. The Fredericton-based startup Chinova Bioworks, which she co-founded in 2016, produces an all-natural preservative based on mushroom fibre.

Chinova Bioworks is the first to introduce natural mushroom chitosan fibre as an all-natural preservative ingredient for food, beverages and cosmetics. Working out of the University of New Brunswick, Huq's lab uses locally sourced mushrooms from farms in Nova Scotia and New Brunswick to produce her unique preservative, a product the company has named Chiber mushroom extract.

The extract works by destroying bacterial cell walls in a wide range of bacteria, yeasts, moulds and pathogens. It's an effective anti-microbial and anti-oxidant, fully soluble and customizable to target specific spoilage micro-organisms. It can't be seen, smelled or tasted on food or in beverages.

"Consumers want simple, authentic, real food that is free from synthetic hormones, antibiotics and preservatives," the biomaterial and polymer scientist explains. Clean-label foods are no longer just a trend, Huq says; they are a reality that food producers must consider.

Originally from Bangladesh, Huq completed an undergraduate and master's degree in applied chemistry at the University of Dhaka. It was there that she began studying polymers with an interest in protecting the environment. "There is so much plastic waste in Bangladesh," Huq admits, "It's destroying our planet. I got interested in how to replace plastics with natural fibres, and then began working in nanotechnology, and then microbiology." Huq came to Canada on a scholarship to do her PhD in Quebec in food microbiology and nanocomposites. Upon completion of her degree, she arrived in Fredericton in 2016 with her husband.

Chinova received pre-seed investments from the New Brunswick Innovation Foundation, SOSV and the First Angel Network, topping it up last year with \$2.6 million in seed funding from several foodtech venture capital firms. Currently targeting food and beverage applications, the company recently concluded its first pilot-scale production and is gearing up for a product launch of the extract in the U.S. in October, with plans to extend Chiber to cosmetic applications by 2022.



The global clean-label ingredient market is expected to grow to

**US\$47.5 billion
by 2023.**

A TASTE OF

FEMALE 'foodpreneurs' ARE MAKING THEIR MARK

By Jana Manolacos

FROM the kitchen to the corner office, Canadian female “foodpreneurs” are commanding their share of the economic pie. From coast to coast and even on Parliament Hill – where the 2018 federal budget earmarked \$1.5 billion in new financing for women business owners – leaders like Chickapea Pasta’s creator Shelby Taylor and Summer Fresh Salads founder Susan Niczowski are making their mark, creating jobs and nurturing their communities in the once male-dominated food industry.

CHICKAPEA PASTA

The idea for Chickapea started when Shelby Taylor, a Collingwood, Ontario, health food store owner at the time, began looking for a healthy and convenient meal option for her new baby. Aware of a bean-based pasta that became one of her store's top sellers, Taylor took the leap into entrepreneurship and decided to create her own variation. Chickapea Pasta is made with just two ingredients: chickpeas and lentils. The product is high in fibre and protein, and free from gluten, added sugars and artificial ingredients. In the past three years, Chickapea Pasta has grown to 2,500 stores across North America.

choosechickapea.com

NONA VEGAN FOODS

Kailey "Sauce Boss" Gilchrist turned her late mother's recipe for cashew-based alfredo sauce into an award-winning, Toronto vegan food company, Nona Vegan Foods. What started as a little heart-powered, one-sauce business out of her home kitchen has, over a few short years, grown into a thriving business with a full range of sauces. Her early days working in a health food store helped Gilchrist recognize that her cashew cream sauce filled a unique market niche. By offering free in-store demonstrations, she got more stores to carry her product and finally landed a contract with Whole Foods in 2015. Today, her retail business has expanded across Canada and into the United States.

nonavegan.com



HAPPY POPS

Happy Pops was founded in 2016 by Leila Keshavjee. As a kinesiology graduate with a passion for health and nutrition, Keshavjee soon found herself in the entrepreneurial lifestyle and was determined to create a product that was both healthy and tasted delicious. Happy Pops crafts all-natural, dairy-free and vegan ice pops that are perfect for breakfast on the go, as a healthy dessert or even as a refreshing afternoon snack. Since launching, Happy Pops has catered almost 500 events and acquired Sweet Sammies Ice Cream Sandwich Co., both found in specialty retailers and farmers markets in Toronto.

happypops.ca

JASWANT'S KITCHEN

Jaswant Kular and her three daughters launched Jaswant's Kitchen in 2010, offering cooking kits and spice blends to help home chefs easily prepare authentic Indian meals, from scratch. That same year, the mother-daughters team won the People's Pick award at the 2010 Good Food Festival in Toronto – a win that turned out to be pivotal for the small company, which had initially started as a part-time venture. In 2015, Jaswant's Kitchen was one of eight inaugural cohorts for the Toronto-based incubator Food Starter, which helps early-stage food processors commercialize and scale the development of their food products. Today, the products are available through over 40 retailers, and they're looking at expanding into integrated food services.

jaswantskitchen.com

YUMI ORGANICS

Looking to buck the no-carb trend, dietitians Zoey Li and Yin Hong set about creating a platform to educate consumers and help them make better nutrition choices. In 2016, with encouragement and financial support from McGill's accelerator, the original diabetes support program they started as graduate students grew into Yumi Organics, the first overnight oats company in Canada – instead of heating up the oatmeal, it's soaked in milk overnight. The award-winning company offers a clean label, vegan, low-sugar product that features organic oats from Quebec, in four flavours: Blueberry Coconut, Matcha Green Apple, Dark Chocolate and Apple Cinnamon.

yumi-organics.ca



THE CHUFA CO

Andrea Orazi and her husband, Scott Abraham, launched The Chufa Co. in 2016. "Chufa" is Spanish for tiger nut, a chickpea-sized, iron-rich root vegetable used in making non-dairy products. Their allergen-friendly vegan ice cream made from chufa was the outcome of a yearlong R&D journey that began with the company owners looking for a way to extend the shelf life of chufa milk. Freezing it offered the best solution. Perfecting the recipe was made possible with support from accelerators like George Brown College's FIRSt, IRAP, the Ontario Centres of Excellence, the York Entrepreneurship Development Institute (YEDI) and seed funding through Bioenterprise. They also participated in the Food Starter program (foodstarter.ca).

thechufaco.com

MI & STU FOODS

After opening a bakery in 2012 that specialized in kosher and gluten-, nut- and dairy-free goods, success took a different turn for cofounders and long-time neighbours Stephanie London and Mimi Bercovitch. They planned on retail sales as a main revenue source, but today, the products are produced in a 7,500-square-foot space in LaSalle, Quebec, for the wholesale market and hospitality industry, and their annual revenue has tripled since they began. Mi & Stu has seen the largest growth in the travel industry, where they are subcontracted to an airline caterer for their gluten-free meals, while their muffins are carried by Via Rail.

miandstu.com



SUMMER FRESH SALADS

When Susan Niczowski and her mother saw a gap in the market for gourmet salads in 1991, it was like finding a rough diamond in the dirt. The two grasped the opportunity to launch Summer Fresh Salads, a company they started almost 30 years ago with a \$100,000 RBC loan and 20 recipes. Today, the Canadian company offers a range of spreads, salads and appetizers which generate \$100 million in annual sales (80 percent in Canada, the rest in the U.S.). Niczowski works with her sister to oversee 300 employees and two food processing plants in Woodbridge, Ontario.

summerfresh.com

MANJIT MINHAS

Entrepreneurial Tour de Force

By Jana Manolakos



When she was 19 and just one year over the legal drinking age, Minhas gave up pursuing a degree in petroleum engineering at the University of Regina, and sold her car to start what would become Minhas Breweries, Distillery and Wineries, scraping together an initial investment of \$10,000 with her younger brother Ravinder.

That was 1999.

HERS is the face that could have launched a thousand ships, but instead this stunning, petite brunette launched a Canadian beer, wine and spirits empire with sales topping \$187 million last year. Meet Manjit Minhas, an entrepreneurial tour de force and a perpetual motion machine whose high energy catapulted Minhas Breweries, Distillery and Wineries, a company she co-founded with her brother 20 years ago. It's now in the global spotlight as the ninth largest brewery in the world, a far leap since first opening its doors as a small importer of private-label spirits for a chain of liquor stores her parents owned in Calgary.

Today, Minhas' calendar is packed with business meetings, pitches and deals; and, an all-important Saturday morning date with one of her two daughters for a school art project. Tonight she's flying home to Calgary, Alberta, having just finished a promotional appearance in Vancouver for *Dragon's Den*, the popular television series on which she appears as one of six dragons, all business moguls and powerhouse investors.

When she was 19 and just one year over the legal drinking age, Minhas gave up pursuing a degree in petroleum engineering at the University of Regina, and sold her car to start what would become Minhas Breweries, Distillery and Wineries, scraping together an initial investment of \$10,000 with her younger brother Ravinder. That was 1999. Three years later, they began importing beer, and in 2006 bought an established Wisconsin-based brewing company.

"We were now a real brewer and we owned the brewery. And that was definitely our 'We made it' moment. It gave us the confidence to dream even bigger, and to keep moving forward in lots of different ways," says Minhas.

Unable to find a supplier in Canada for their spirits, the sister and brother duo had turned to the United States, connecting with one in Kentucky. Minhas explains, "Because of NAFTA, we were able to bring alcohol back to Canada and vice versa when we got filter facilities in Calgary. NAFTA definitely was a big part of our success, and still is."

Since then, the company has seen continued growth with assets that include the Calgary-based Minhas Micro Brewery, the Minhas Distillery, Minhas Winery and Minhas Kitchen located in Monroe, Wisconsin. A superlative deal maker and branding maven, Minhas secured a lucrative agreement with Costco, to make all of the Kirkland-brand beer worldwide, as well as all the craft beers under the Trader Joe's label in the U.S. Today the company accounts for 120 name-brand beers, wine, spirits and liquors and distributes products in 20 countries, 40 U.S. states and almost all of Canada.

They were dealing with so many different brands, creating private labels and different point of sale materials that it became costly to contract out. "Early on we decided that we needed to be as vertically integrated as possible along this journey, so we started a graphic design company," Minhas says. Similarly, they own a trucking company and TV production studio which was started six years ago to make their own commercials and support advertising. Spotlight Productions is now the fourth largest production company in Canada.

"It allowed us to be faster than everybody else in our industry, from conceptual ideas to actually having product on shelves. That's definitely been one of the keys to our success: our speed," she explains.

While U.S. tariffs on aluminum have left an impact along with a weaker Canadian dollar, for Minhas it's just part of business. "They definitely have affected us in our bottom line, but it happens to everybody. We're not unique. There are a lot of things that a business owner doesn't have control over, and you just have to keep going."

Five people sit on the company board of directors which includes two women, steering the largely male workforce. Minhas admits, "Manufacturing is still so male dominated. When you're looking for mechanics and forklift drivers and delivery drivers, there just aren't women who are attracted to those jobs." She points out that among the 300 employees, women can be found mostly in departments like accounting and finance, with a few more in the manufacturing plant.





TAKING A BITE

out of Canada's food waste problem

By Jana Manolakos

WHILE most Canadians seem to be throwing away or wasting food, 1.4 million children across Canada are struggling to have enough to eat, according to a landmark report issued earlier this year by Toronto-based food rescue organization Second Harvest and Value Chain Management International (VCMI), a global food waste authority.

Their report, "The Avoidable Crisis of Food Waste," says that nearly 60 percent of food produced in Canada – amounting to 35.5 million metric tonnes, equivalent to over \$49 billion – is lost and wasted annually, while 11.2 million metric tonnes (32 percent) is edible food that could be redirected to support people in our communities. The report stems from a year-long research project built in part on earlier work by Martin Gooch, CEO of VCMI.

"We believe the numbers we found are actually conservative," says Second Harvest CEO Lori Nikkel, adding that this is "a world first" for several reasons, one of which is that the report offers standardized global measurements. Although Nikkel admits that the data may not be relevant to less affluent nations, the methodology could be applicable. The report offers a framework to enable accurate and consistent measurement of food loss and provide clearer direction to government, industry and consumers. Second Harvest has already talked with the UN's Food and Agriculture and Environment organizations and is currently engaged in "confidential conversations with some other international players" who expressed interest, Nikkel says.

Lori Nikkel, CEO,
Second Harvest





With a passion for food rescue stemming from her days as a low-income, single mother looking to feed her three young boys, Nikkel explains, “We have lost the intrinsic value of what food is. We have turned it into a commodity, not the life-nourishing sustenance it is supposed to be. We are a consumer-driven society.” She points to the practice that some grocers have of throwing out produce like potatoes, simply because they are the wrong size for that time of the year. “We produce enough food for 55 million Canadians, including imports. But there are only 37 million of us, so how do we manage it? We have to measure it,” Nikkel says. “We found that there is an economic benefit to businesses for preventing this loss. But if we are not measuring, how would you know?”

Some 20 years ago, Nikkel volunteered to run the student nutrition program so her boys could have access to good food in their Etobicoke school. That’s the first time she realized there was surplus food: “I would go to Loblaws and other places and ask for extra food, and the food we got was amazing. It was fresh.”

After more than three decades of grassroots donations, she admits Second Harvest has come into its own. “We are trying to disrupt the whole system. We are trying to deinstitutionalize, demystify and destigmatize food,” says Nikkel. “We are not a food bank – we are experts in perishables. We don’t purchase any food. Everything is rescued. And we have an environmental lens. We go further up the supply chain so we are at farms, at processors and manufacturers, at distribution centres.”

The organization’s move into the innovation space includes foodrescue.ca, a Second Harvest program Nikkel conceived which offers an online resource that makes it easier for local organizations to donate food right in their community. She says that among other government and local support, money from the Walmart Foundation was invested into the platform as a means of addressing food rescue in a more community-based way. “Foodrescue.ca allows for scalability, providing an opportunity for smaller yields of donations or larger. It also painted a picture of how abundant food was,” she notes.

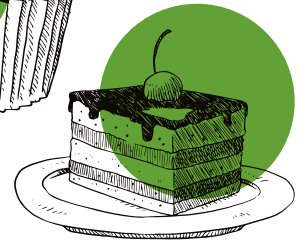
Food waste is a complex problem that needs leadership, says Nikkel. “There are definitely leaders out there in industry, government and academia, but we have to connect. We need leaders in every space.” She suggests that businesses interested in donated their food begin with an audit of their system, and they should not overlook their employees for ideas.

While not a big fan of regulation, Nikkel says policies, legislation and regulations need to align themselves with food loss and waste. For example, she would like to see a change to regulations around agricultural crop insurance where harvest that is unsellable is donating instead of discarded, as is the current practice. **fB**

Every year
56.5 million tonnes
 of CO₂ equivalent
 emissions are created
 by food waste
 in Canada.

With a passion for food rescue stemming from her days as a low-income, single mother looking to feed her three young boys, Nikkel explains, “We have lost the intrinsic value of what food is. We have turned it into a commodity, not the life-nourishing sustenance it is supposed to be. We are a consumer-driven society.”





The Secret Sauce of EDIBLE CANNABIS IN CANADA

By Carol T Culhane, PHEc, MBA; President, International Food Focus Ltd.

If all goes according to plan, by October 17, Canada will have federal regulations which enable the sale of edible cannabis products.

The federal government's steadfast adherence to its roll-out of legalized cannabis in many forms illustrates its commitment to the three-pronged aim of this new legislation, which are to:

- keep cannabis out of the hands of youth
- keep profits out of the pockets of criminals
- protect public health and safety by allowing adults access to legal cannabis

per package limit and to substantiate the mandatory CBD/THC content declared on the product label, but moreover, to allow users to confidently consume the amount of THC which is appropriate to their needs.

Secondly, cannabis oil, as the critical intermediate step to the production of edible cannabis products, is the pathway to THC dose standardization. The formula for any one of the edible cannabis products proposed by the federal government (herbal teas, non-alcoholic beverages, baked goods, confectionery items, etc.) will include incorporation and calibration of the "secret sauce" – the THC-standardized cannabis oil.

While the ways and means of making cannabis oil have been known to edible cannabis bakers for 50 years or more, the standardization of the amount of CBD/THC in cannabis oil has either escaped the controls of these artisans, or never crossed their minds. To date, the cannabis-producing sector is yet able to standardize, in both bench and scaled-up proportions, cannabis oil with a reliable and consistent proportion of CBD/THC. Familiar to the food manufacturing sector, is the potential effect of processing (baking, extrusion, pasteurization, etc.) on the level and efficacy of THC in the final product. If examination indicates that the level of THC is compromised by any one means of processing, the degree of loss must be verified and overages added to the formula to meet targeted CBD/THC content declarations.

These are only some of the challenges facing this emerging sector in the Canadian food manufacturing space. We will provide updates as more details are available, particularly once the regulations are finalized. There is an inherent opportunity for one or more entrepreneurial food manufacturers who are prepared to weather the highs and lows, much less the costs, of bench-level research, and who are open to partnering with other trailblazing entities, such as Multiple Sclerosis Canada and the CIHR. Why not pick up the phone and give them a call? **FB**

THE edible cannabis regulations are secondary in succession to the recreational cannabis regulations; however, they are equally important to achieving the official goals of the program. A 2016 U.S. study reported that 29 percent of recreational cannabis users had consumed the edible form; in addition, 11 to 26 percent of medical marijuana users, in selected U.S. states and in Canada, had consumed an edible cannabis product at least once. In 2014, in Colorado, where edible cannabis products are legally sold, edible retail cannabis-infused products accounted for 45 percent of annual cannabis sales. Since the broad range of cannabis products sold in Colorado will not be legalized in Canada, one cannot extrapolate the proportion of edible cannabis sales onto the Canadian market. One can safely project, however, that edible cannabis will have a significant reach in Canada and be of interest to approximately 30 percent of cannabis users.

The appeal of edible cannabis is tangible. Although no clinical trials on the therapeutic efficacy of cannabis are known to have been conducted to date, anecdotal evidence indicates that cannabis can be an effective pain-management tool for some sufferers of a wide range of muscular aches and pains, ranging from those which are the result of accidents to that which accompanies crippling diseases. To this end, the Multiple Sclerosis Society of Canada has partnered with the Canadian Institute of Health Research (CIHR) in a pledge of \$1.5 million to investigate how cannabis can manage MS symptoms and its effect on the disease.

Edible cannabis offers users several advantages. The orally ingested variant is physiologically safer than the vaped or smoked variants. A user need not smoke or learn to smoke to acquire the cannabis benefits. Finally, edible cannabis products can be discretely consumed anywhere and everywhere, void of the blue-smoke tell-tale and pungent, characteristic odour.

The challenges facing an edible cannabis retail market in Canada are many. The label of an edible cannabis product needs to declare the amount of psychoactive component THC (tetrahydrocannabinol) and the amount of non-psychoactive component CBD (cannabidiol) per package, or per unit in the package. The primary challenge is standardization of the amount of these ingredients per unit of sale. The proposed regulations specify an upper limit of 10 mg THC per "package." Said package could consist of 10 individual units having 1 mg THC each, or one unit having 10 mg THC. A minimum amount of THC per package is not proposed, and most likely will not be for some time to come. This is because the minimum efficacious amount for the average adult is not known to anyone, including the regulator. As stated by Keith Woelfel of Colorado's Stillwater Brands, "Accurate THC edible dosing is as difficult as it is important, wherein the difference between 5 mg and 10 mg can be one of feeling better and feeling useless."

Further, even a 5 mg dose may be excessive for some users, given individual metabolic differences. Thus, accurate dosing is essential, not only to remain under the 10 mg THC

Accelerating Prosperity: The Life Sciences Sector in Ontario



Drugs and Pharmaceuticals



Research, Testing and Medical Laboratories



eHealth/Artificial Intelligence



Agricultural Feedstock and Chemicals



Medical Devices and Equipment



Medical Cannabis



Snapshot of Ontario Life Sciences



\$8.8 billion

in government revenue contributions



Life Sciences Sector Potential

If Ontario's life sciences sector, enabled by a coordinated sector strategy, follows a similar growth trajectory as experienced by other leading jurisdictions, Ontario may realize the following incremental economic contributions over the next decade.



Life Sciences Sector at a Glance

89,842 direct jobs at 6,140 firms

23% decline of Ontario's share of Canadian venture capital (VC) since 2007

19.3% job growth since 2006



4% of total equity raised on TSX/TSXV

~191,000 jobs sustained through direct, indirect and induced contributions

51% of Canada's R&D spending in life sciences

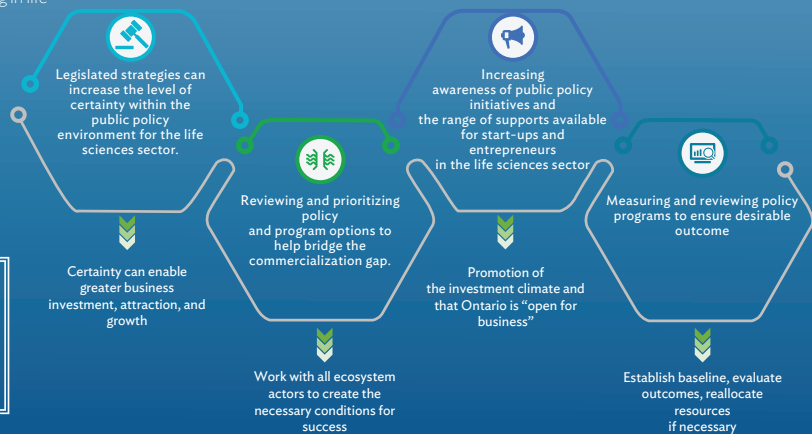
17.9% unemployment rate facing youngest science graduates

60% of firms have less than 10 employees

Nearly \$57 billion in revenues

23.6% higher wages than provincial avg.

What can Ontario learn from other leading life sciences jurisdictions?



Accounting for direct, indirect and induced contributions, the life sciences sector supports an estimated total employment of ~191,000 jobs for Ontarians.



Life Sciences Ontario advocates for the economic strategies needed to drive greater growth in our sector

You can help by { } AND { } #lifesciences

Joining LSO to help create an even stronger life sciences sector in Ontario

Source: Life Sciences Ontario Sector Report 2019 <http://bit.ly/2019SectorReport>

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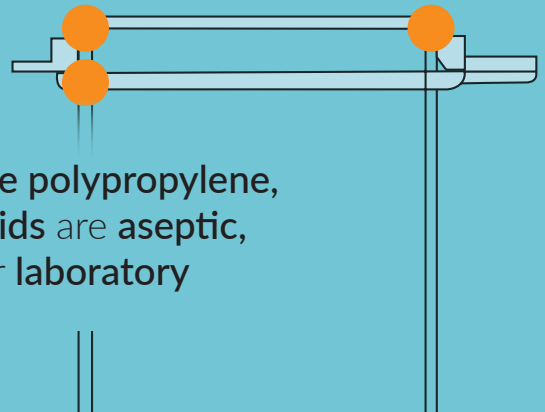
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Canadian Museum of Nature, Ottawa.
Photo credit: Bill Manolakos

THE TRAILBLAZERS

This past March, the doors closed on a seven-month exhibit at the Canadian Museum of Nature in Ottawa, honouring 20 Canadian women in natural science and marking 100 years since women won the right to vote in federal elections. These are Canada's leading ladies in the natural sciences.

Catherine Jeremie (d. 1744)

After settling in Montreal in 1702, Jeremie studied botany and midwifery. Her interest in Indigenous knowledge led her to use native plants in her practice. One of the earliest botanists in Canada, she sent specimens to France which are still in the National Museum of Natural History in Paris.

Christian Ramsay Dalhousie (d. 1839)

Dalhousie came to Canada in Scotland in 1816 with her lieutenant-governor husband. A keen botanist, she spent years collecting and cataloguing Canadian plants and taught other women to do the same. She created one of the earliest herbariums in Nova Scotia.

Catherine Parr Traill (d. 1899)

Parr Traill was one of the first settlers to publish in detail about Canada's climate, plants and animals. She also created plant collections that contributed to the knowledge of natural history in Canada at the time. Her most famous book, *The Backwoods of Canada* (1836), describes her life as a pioneer.

Harriet Brooks (d. 1933)

The physics research of Brooks serves as one of the foundations of nuclear science. Her work led to the discovery that radioactivity results from the disintegration of atoms. The first woman nuclear physicist in Canada, she was also one of the first to discover radon. She had to retire from her career at 31 because she got married.

Carrie Derick (d. 1941)

Derick was a botanist and geneticist who was also a writer and a social activist, fighting for women's rights. She was the first woman university professor in Canada and a founder of McGill University's Genetics Department. President of the Montreal

Suffrage Association as far back as 1915, she was arguing for the legalization of birth control, which finally occurred in 1969.

Alice Wilson (d. 1960)

Despite lifelong health problems and limited career opportunities, Wilson never gave up on her quest to understand the earth beneath her feet and the fossils it contained. She was the first woman geologist and palaeontologist at the Geological Survey of Canada and a world expert on the geology of the St. Lawrence Lowlands.

Isabella Preston (d. 1965)

Preston created garden plants that were hearty enough to survive Canadian winters, and she was the first Canadian woman to hybridize them. She created about 200 garden hybrids (lilies, lilacs, crab apples and roses).

Margaret Newton (d. 1971)

Wheat stem rust was once the most feared disease affecting wheat crops; Newton's agricultural research led to the development of varieties that are resistant to the disease. Thanks to her work in the 1930s, crop losses went from 30,000,000 bushels of wheat a year to practically zero. She was internationally renowned for her research on wheat rust, and she was the first female senior plant pathologist at the Dominion Rust Research Laboratory in Winnipeg, Manitoba.

Marcel Gauvreau (d. 1968)

A botanist, Gauvreau started the School of Awakening in Montreal, Quebec, which was dedicated to introducing science to children. Her educational approach was innovative, encouraging spontaneity, experimentation and learning. She developed children's science programs for television and radio, and made significant contributions to *The Laurentian* (cont.)

In 1920, Canada's Privy Council Office banned married women from holding full-time positions in the federal government. Exceptions were made for women whose husbands were unable to work. The ban ended in 1955.

(continued from previous page)

Flora, the first comprehensive plant record of southern Quebec. Gauvreau also wrote several children's books about appreciating nature.

Francis Wagner (d. 2016)

Wagner's research helped map Canada's geology, both terrestrial and marine. As a palaeontologist, her career took her on many gruelling research trips, from the Caribbean to the Beaufort Sea and from the Bay of Fundy to the Salish Sea. She was a leading specialist in micropalaeontology, studying single-celled fossils.

Anne Innes Dagg

Dagg's obsession with giraffes began when she visited a zoo at the age of three. Twenty years later, in order to find a place to stay in South Africa, she had to fight to convince locals to let her stay, and her persistence paid off. Dagg is the first western scientist to study animal behaviour in the wild in Africa, writing some of the first scientific publications on giraffes.

Helen Battle (d. 1994)

Battle was one of the first zoologists to do marine biology research in the lab, as opposed to at sea. She showed that the study of microscopic tissues could provide answers to marine problems. Battle was the first Canadian woman PhD in marine biology, and one of the first scientists to use fish eggs to study the effects of cancer-causing substances. A founding member of the Canadian Society of Zoologists, Battle taught at the University of Western Ontario for several decades.

Viola MacMillan (d. 1993)

For the majority of her career as a mineral prospector, MacMillan was the only woman working in an industry ruled by men. She discovered several major, commercially exploitable gold deposits in Canada. MacMillan was the first woman member and later the first woman president of the Prospectors and Developers Association of Canada, and the first woman named to the Canadian Mining Hall of Fame.

Mildred Nobles (d. 1993)

Nobles studied tree fungus and created methods for identifying wood-rotting fungi, which led to better forest management across Canada. She invented the Nobles Species Code, a system widely used to identify wood-rotting fungi, and wrote *Identification of Cultures of Wood-rotting Fungi*, a publication that established her as a world-leading expert.

Kathy Conlan

Conlan is a marine biologist at the Canadian Museum of Nature. She works to understand how the Arctic and Antarctica are affected by environmental change, and discovered that the world's largest iceberg can affect ocean-bottom marine life

more than 100 km away when it blocks the annual Antarctic plankton bloom, a main food source. She is listed as one of Canada's greatest explorers by *Canadian Geographic*. To date, Conlan has gone on more than 20 expeditions to the Arctic and Antarctic.

Anne de Vernal

Understanding the past to predict the future as a paleo-oceanographer at the University of Quebec in Montreal, de Vernal investigates changes in northern marine environments over millions of years. She finds clues in microscopic fossils that can tell us about our planet's future and is one of the first to use fossils of a kind of plankton (dinoflagellate cysts) as indicators of climate change.

Gwen Bridge

Bridge studies forest hydrology (the movement, storage and quality of water in forests). Her scientific expertise, as well as her identity as a member of the Saddle Lake Cree Nation, fuels her work with First Nations groups to improve their management of natural resources. Bridge wrote a Memorandum of Understanding between First Nations and the Canadian Wildlife Service on species at risk.

Natalia Rybczynski

A palaeontologist, Rybczynski has led a number of arctic expeditions resulting in the discovery of several new fossil species. One of these new species is *Puijila darwini*, a semi-aquatic mammal that sheds light on how seal ancestors made the transition from land to sea. She discovered an evolutionary "missing link" between land-dwelling mammals and modern seals, and found the first evidence of a 3.5-million-year-old High Arctic camel. Rybczynski was named one of Canada's greatest explorers by *Canadian Geographic*.

Joyce Boye

Boye specializes in plant proteins and develops more nutritious products and processing techniques for protein-rich foods such as chickpeas and soybeans, among other peas, beans and lentils. Boye was named Special Ambassador for the 2016 International Year of Pulses by the UN Food and Agriculture Organization and contributed to its consultation on the importance of protein quality in human nutrition.

Victoria Kaspi

An astrophysicist, Kaspi studies neutron stars. Because neutron stars start out as another kind of star, her work sheds light on the evolution of the universe. Kaspi is the first woman and youngest person to receive the Herzberg Medal, Canada's top award for science and engineering with a prize of \$1 million; she discovered a rare magnetar, a neutron star with an extreme magnetic field. (Read more about Kaspi on p.13.) **BL**



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