Future Ready

Faculty of Engineering
Major Gift Report 2019-2020

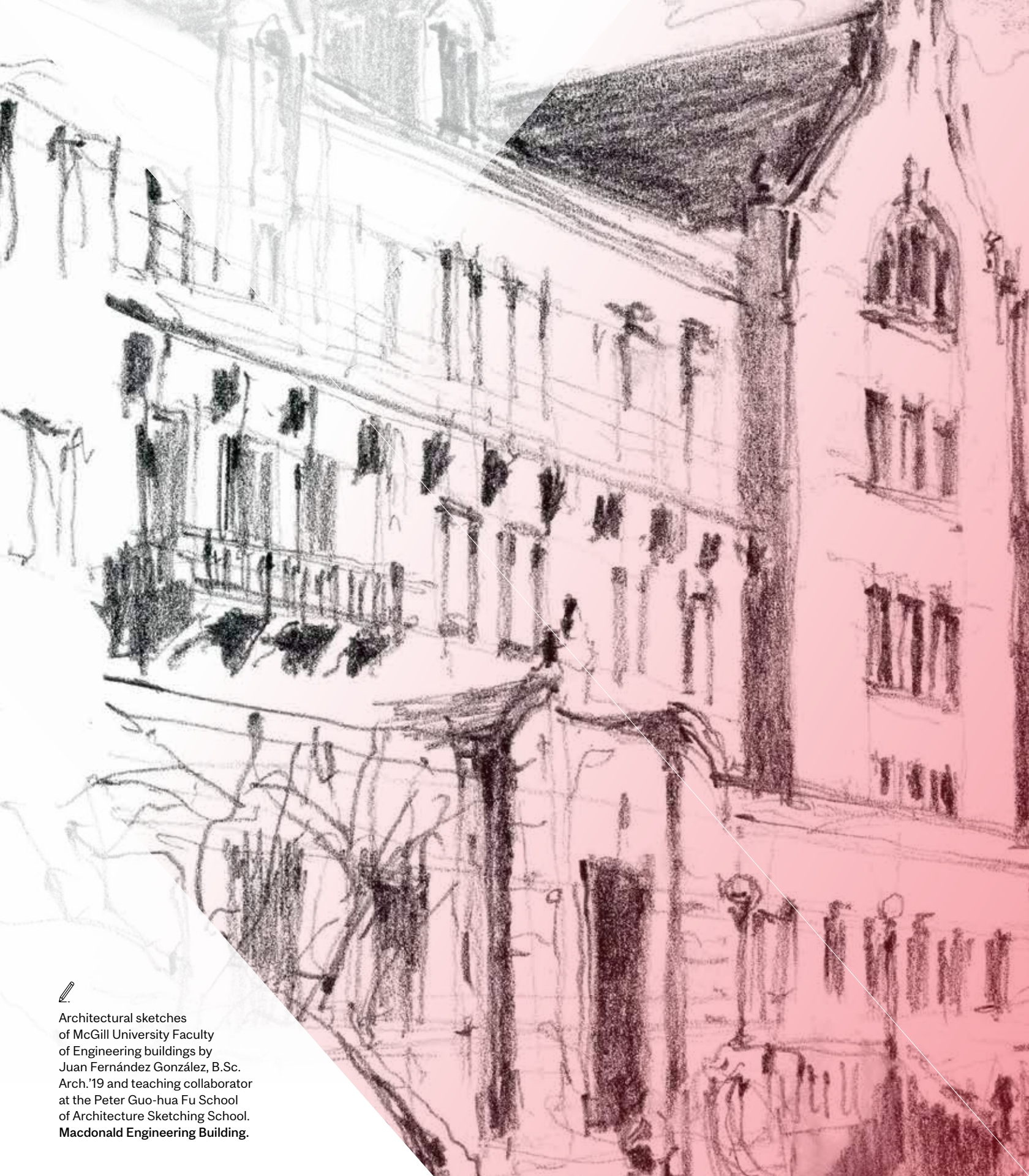
MADE by McGill

Thank you!

And please keep safe.

“Real generosity towards the future lies in giving all to the present.”

– ALBERT CAMUS



Architectural sketches of McGill University Faculty of Engineering buildings by Juan Fernández González, B.Sc. Arch.'19 and teaching collaborator at the Peter Guo-hua Fu School of Architecture Sketching School. **Macdonald Engineering Building.**

Thank you!

2020 has been a watershed year. It has shown us the importance of preparing the next generation of engineers, architects and urban planners to be ready for the challenges to come. Being future-ready means being able to adapt to uncertainty and demonstrate leadership by understanding the global picture of problems that matter. We at the Faculty of Engineering thank our committed community of generous benefactors for supporting us and making this possible.

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“The pride that I have in this Faculty and the purpose-driven work we do is deeper than ever. It is your support that makes all these things possible.”

Jim A. Nicell, Professor, Department of Civil Engineering, Dean, Faculty of Engineering

GOPESA PAQUETTE

Future-Ready
A Message from the Dean

On March 13, 2020, our world closed in on us. Following government directives, we shut down our campus operations and rapidly switched to online teaching and research. Over the course of the following weeks and months, as we worked to finish the Winter 2020 term, making sure our students could graduate on time, we were extremely heartened to see our community come together in support of the Faculty. Your generosity, your involvement, and all the ways in which you care, have a huge impact on how we teach and do research. This report illustrates some of the many projects and initiatives that your support makes possible. And for that, we truly thank you.

Engine—the Faculty's Engineering Innovation and Entrepreneurship Centre, was founded thanks to philanthropy, and plays a major role in enabling us to train our students to be future-ready, helping them develop their ideas into products that make a difference in people's lives. For example, the Made for All Code Life Ventilator Challenge, with the goal of designing and manufacturing affordable ventilators for patients of COVID-19 and other respiratory diseases, benefitted greatly from your ready and generous support. The winning team, Haply Robotics, is a start-up company founded by McGill Mechanical Engineering alumnus Colin Gallacher (BEng'13, MEng'15), whose experience as a student was enriched by Engine; Colin's story is profiled on page 45 of this report. Engine has grown incredibly over the past five years, and we look forward to its next five, innovating for the public good.

In many ways, the COVID-19 pandemic took the world by surprise. For decades, health experts had warned of the dangers of such a pandemic, but these warnings were not heeded enough. Yet in many ways, we, the scientific and engineering community, were ready. At the Faculty, we pivoted our research very quickly, meeting the COVID-19 challenge with more than 30 research projects, including working on a vaccine and developing rapid point-of-care testing methods. The COVID-19 crisis is at the juncture of two fields that the Faculty of Engineering prioritizes greatly—sustainability and healthcare, which are covered in sections 2 and 3 of this report.

As our Trottier Institute for Sustainability in Engineering and Design (TISED) September 2020 event "Lessons from a Pandemic: Solutions for Addressing the Climate Change Crisis" explored, climate change and the pandemic are linked. Both require that we take more seriously the knowledge that scientists give us and that we do a better job at spreading scientific literacy among the wider public. We live in a world where everything is connected, and we need to educate the next generation of design professionals to be able to make those connections. This includes an understanding of the insights of those from the arts and humanities who have much to contribute in solving the global problems that matter.

Under the Paris Agreement, Canada committed to reducing its greenhouse gases (GHG) by 30% below 2005 levels by 2030: by now, climate change and sustainability have become an integral part of the way we educate our students. The pandemic has allowed us an even clearer understanding of the importance of sustainability not just for human prosperity, but for our survival as a species. Beyond simply "going green," sustainability means a broader understanding of, and responsibility for, what our needs are as a global society. Universities such as McGill must play a stronger role in the global conversation and our need as a society to build greater trust in science and data.

As the pandemic has reminded us, healthcare is a human right. McGill University's Global Health Programs are world-renowned, and growing to meet human needs, especially in developing countries. Technological innovation is central to bringing healthcare to all, at a global level. Our new Department of Bioengineering, whose first students graduated in 2020, the year of the pandemic, was established through philanthropy, and is now gathering together a truly stellar group of professors leading the way. We speak to Professor Dan Nicolau, the Marika Zelenka Roy Chair in Bioengineering, on page 41 to understand how the future of medicine may lie with engineers and their problem-solving approach.

The pride that I have in this Faculty and the purpose-driven work we do is deeper than ever. It is your support that makes all these things possible, and it is your giving that helps us make such an impact on society, as you create change for the betterment of society through McGill University.

The world is always evolving around us and change is hard, yet I am hopeful for our future. Being future-ready means knowing how to adapt to what's coming, to what we know and what we don't know yet; it means learning to thrive and excel and triumph in the midst of competing constraints, difficult circumstances, and new and unforeseen challenges. We've shown we can do it. I am proud that we have adapted so well, making as much lemonade as possible from the lemons we've been fed over the past year. I am firm in my belief that we are going to come out stronger from this than ever before.

Thank you.

Jim A. Nicell, PhD, PEng, FCAE
Dean, Faculty of Engineering

Engine (Innovating for social good)

ACRYLIC (PHOTO: JUSTIN BISSON BECK / ARTISTIC EDIT: CAMILA GUTIÉRREZ)

The McGill Engine, from the Faculty of Engineering, supports technological innovation and entrepreneurship, enabling students and professors to turn their creative technological ideas and research into products that improve people's lives.

Established in 2013 thanks to philanthropic donations, the McGill Engine Centre has helped bring dozens of creative student and faculty research projects to life and to market. We celebrate the donors whose generosity and involvement have made Engine's growth and creativity possible, and we look forward to Engine's future developments!

Building Synergy

Engine Director, Professor Benoit Boulet's vision is for the Faculty of Engineering's innovation and entrepreneurship hub to become a wider center for cross-disciplinary collaboration across and beyond McGill.

Entrepreneurship runs deep in Professor Boulet's family. His grandfather started a shoe company now making cowboy boots in Saint-Tite, Quebec during the Great Depression nearly a century ago. The family company, Boulet Boots, is still going strong, but as a young man Boulet had his mind set on engineering.

An electrical engineer by training, focusing on automation and control, Boulet teamed up a decade ago with his PhD student Ahmad Haidar (now an Assistant Professor in the McGill Department of Biomedical Engineering at McGill) seeking to do something good for humanity with their technical knowledge. Together they created an "artificial pancreas" for diabetes patients, which automatically doses insulin into the body. After winning the Faculty of Engineering's first William and Rhea Seath Award, they put together a start-up company, which was sold to major pharmaceutical company Eli Lilly and Company, incidentally the first marketer of insulin back in 1923.

"That opened my eyes to the possibilities of technologies becoming innovations in the marketplace: new technologies that can be developed and sold quickly," says Boulet. Since then, as former Associate Dean of Research and Innovation and now current Director of Engine, Boulet has, together with Associate Director of Engine Katya Marc, championed helping students learn how to turn their ideas and research into marketable products, and built Engine into a centre servicing not just the Faculty of Engineering but McGill and the larger Montreal tech industry eco-system. "We tell students: don't just sit there and wait, build it yourself. You're the future engineer, you're the technologist, with all the skills to build what you're dreaming of."

Boulet has a bold vision for what Engine 2.0 can achieve in the future and how it can expand to help develop the next generation of young tech entrepreneurs in the making, bridging deep research and business know-how, sustainability and social utility. He sees Engine as having the capacity to create collaborations across areas such as electrical engineering, computer science, robotics, bioengineering, psychology, medicine and agricultural science, all the way from the Centre for Intelligent Machines (CIM) to the Dobson Centre for Entrepreneurship.

What would make a genuine difference however is old-fashioned bricks and mortar, to create a space that physically brings into close proximity researchers, labs, innovation offices, an incubator and accelerator: "If we're talking about a bigger endeavour, what I would call the $200 million prize, what I'd like is a large space—a shared or co-located 'maker space,' where there would be bioengineering labs, robotics labs, automation, micro electronics. A space where you can actually fabricate things quickly at very high end, in order to truly serve the full of McGill. To have a corridor, a big pipeline of tech innovation. There are so many levels to what we can do."

Engine Director Professor Benoit Boulet seeks to establish an interdisciplinary innovation corridor.

OWEN EGAN

Engine Facts and Figures

(January 2013 to December 2020)

$780K+

IN GRANTS, AWARDS, PRIZES, STIPENDS AND FELLOWSHIPS AWARDED

2700+

ATTENDEES AT OVER 88 EVENTS, SEMINARS & WORKSHOPS

875+

STUDENTS & PROFESSORS ADVISED/COACHED

225+

PROJECT APPLICATIONS REVIEWED

100+

PROJECTS/VENTURES SUPPORTED

480

COMPANY INTERACTIONS FOR R&D COLLABORATION

TECHACCEL GRANTS:

$151,000+

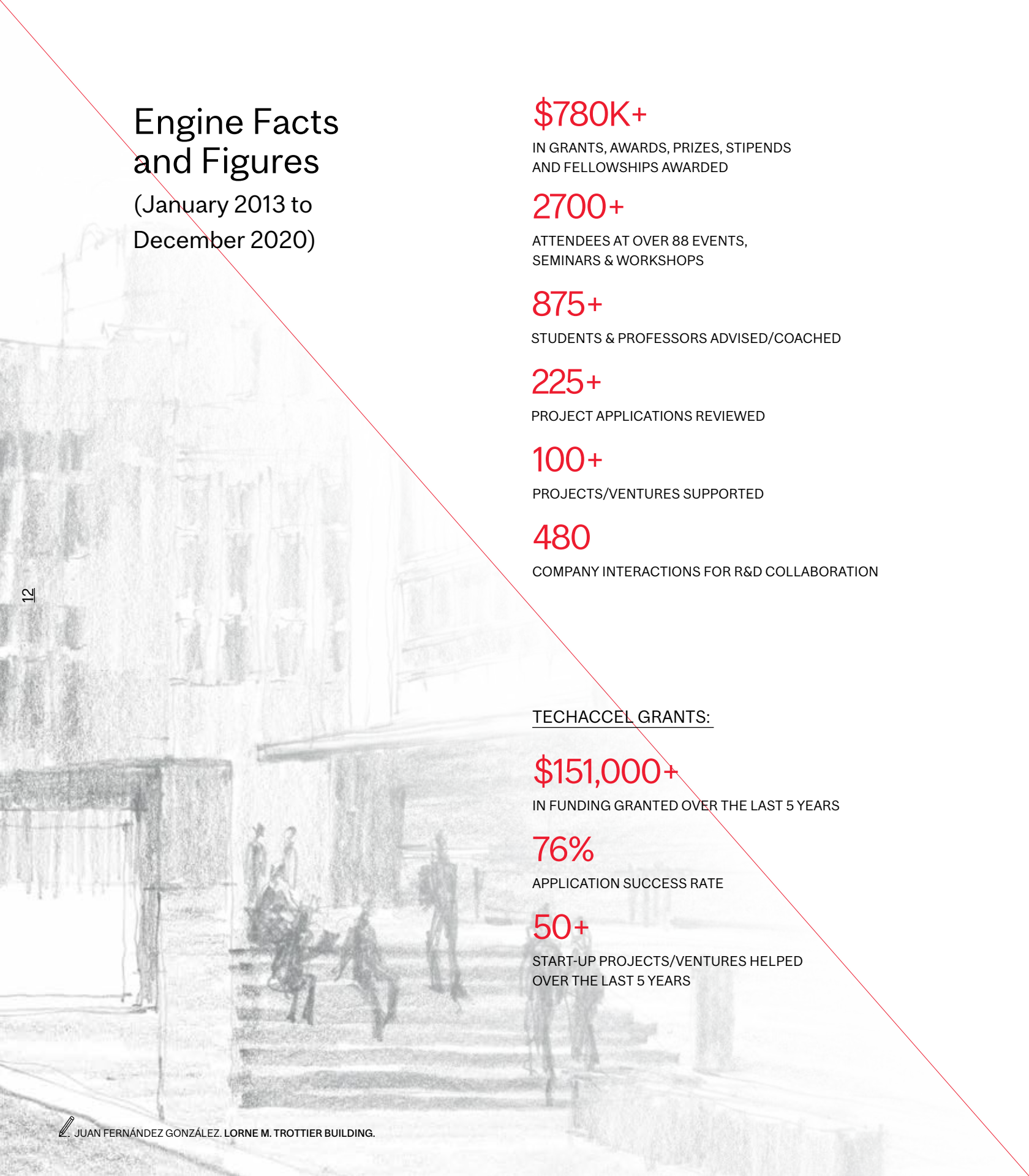
IN FUNDING GRANTED OVER THE LAST 5 YEARS

76%

APPLICATION SUCCESS RATE

50+

START-UP PROJECTS/VENTURES HELPED OVER THE LAST 5 YEARS



JUAN FERNÁNDEZ GONZÁLEZ. **LORNE M. TROTTIER BUILDING.**

Engine
Success Stories

BLUECITY Combines (AI) artificial intelligence and LiDAR (Light Detection and Ranging) sensors to provide more detailed, real-time traffic data to make streets safer for pedestrians, cyclists and motorists.

bluecity.ai

SENSEQUAKE Provides sensor-based structural health monitoring (SHM) and seismic assessment of buildings to governmental organizations, engineering firms and the real estate industry.

sensequake.com

ROKULO Helping mining and construction operations of all sizes significantly optimize their processing circuits and profit margins, enabling real-time operational intelligence through autonomous machine vision camera system.

rokulo.com

TAIGA MOTORS Developing the world's first production electric snowmobile so that current and future generations can continue to explore all of winter's pleasures in harmony with nature.

taigamotors.ca

ORA SOUND Award-winning company using graphene—a material lighter, stronger and stiffer than steel—to build unique, high performance audiophile quality loudspeaker membranes.

ora-sound.com

CARBICRETE Patented technology that allows manufacturers to produce cement-free, carbon-negative concrete with lower material costs and better mechanical and durability properties, reducing concrete makers' carbon footprint.

carbicrete.com

ACRYLIC (PHOTO: MATTHIEU JOANNON / ARTISTIC EDIT: CAMILA GUTIÉRREZ)

Student start-up Acrylic Robotics, founded by Celeste Nantel (BEng'23, left) and Chloé Ryan (BEng'23), uses robotics to generate eye-catching artwork.

CAMILA GUTIÉRREZ

Creating Art to Scale

Student tech start-up Acrylic Robotics applies robotics and software automation to create competitively-priced artworks using real paint on canvas.

At a late-night study session, Mechanical Engineering undergraduates Celeste Nantel (BEng'23) and Chloë Ryan (BEng'23) were having trouble focusing on course material. “We started talking about what we wanted to do next,” says Nantel. “I had experience in robotics, and she had experience in visual arts, so we thought it would be interesting to see how we could incorporate robotics and technology into the painting process.”

The result: Acrylic Robotics, a start-up that Nantel has described as aiming to “revolutionize the consumer art industry by incorporating robotic and software automation into the production process.” Their initial idea led them to McGill Engine’s TechAccel summer program, which provides grants and guidance for students working on technologically based ideas with business potential—and TechAccel’s end-of-summer showcase saw Acrylic take the “crowd favourite” award. “With support from TechAccel we’ve been able to develop our ideas,” says Nantel. “We have a really interesting problem to solve, because there's many ways to think about our product.”

Through participation in the Women Founders Project, an initiative of the student-run venture capitalist group Front Row Ventures, and a successful application for the Next 36 incubator program for Canadian undergraduates, Nantel and Ryan have refined Acrylic into something completely unique. “In our latest iteration, we want to create an ecosystem of hardware and software products to allow artists to produce and sell their art at scale,” says Nantel. “Imagine a paintbrush with sensors that you use like a normal brush, but all your hand motions are tracked in 3D and can be reproduced by a robot. An artist could make a painting once and have their movements recreated an unlimited number of times, so unlimited copies of paintings could be made for the market.”

Disease Detection Made Simpler

With support from a donor-funded grant, a group of recent Department of Bioengineering graduates are eagerly tackling the challenges of bringing medical testing to the masses.

All over the globe, a dangerous infection is circulating. Many of the people carrying it don't feel sick, and are unknowingly transmitting it to others. Testing is available but not always quick and convenient, so most people don't get it done routinely. This scenario describes not only COVID-19, but also several other diseases including chlamydia and gonorrhea, two of the world's most prevalent sexually transmitted infections (STIs).

Mark Kumhyr (BEng'20) and Patrick O'Neill (BEng'20) envision a future where common infections can be detected on the spot, without the need to send samples away to a lab and wait for results. They latched onto this idea during their time as undergraduate students in McGill's Department of Bioengineering. "We recreated the home pregnancy test for one of our classes," says Kumhyr. "It made us wonder why there isn't home testing and point-of-care testing for all kinds of conditions; why don't we see more of this?"

Along with a few of their classmates, Kumhyr and O'Neill launched a venture called LFAnt Medical. Pronounced "elephant,"—a nod to the fact that STIs are the "elephant in the room"—the company is aimed at tackling not only STIs, but also the social discomfort surrounding these diseases. In addition, the first three letters stand for lateral flow assay, the technology employed in the pregnancy test.

Using this technology as a starting point, the team began working on a home urine test for chlamydia and gonorrhea. If they succeed, the impact on public health could be huge. "Once you know you have one of those infections, you can treat it with an inexpensive round of antibiotics," Kumhyr says. "So we were amazed when we saw that the rates had been climbing for the last decade; in fact, they're at an all-time high!"

In 2020, LFAnt was awarded a TechAccel grant, which allowed the founders to spend the summer honing their skills in both business and diagnostics. Besides financial support, the grant also included mentorship from McGill professor Dr. Michael Avedesian. "It was great to have him just a phone call or email away," says O'Neill. "He has a lot of relevant experience in the regulatory field, as well as in entrepreneurship in general."

By autumn, LFAnt had garnered interest from the Government of Canada, which awarded it a $100,000 grant to work on a rapid saliva test for COVID-19.

Medical devices are hit-and-miss: companies often need to experiment repeatedly before landing upon marketable solutions. Regardless how their current projects unfold, the young entrepreneurs are looking forward to contributing to their field. "For me, there's no better industry than medical devices," says Kumhyr. "You're developing something that could have material impact on somebody's greatest asset, which is their health."

LFAnt MEDICAL

The LFant Team, left to right: Adam Melnyk, Michael Phelan, Patrick O'Neill, Mark Kumhyr, Akshay Ben

RAFFLES ZHU

JENNIFER GODDARD

The Problem Solver

After a rewarding career spent advancing crime-solving technology, Robert Walsh is equipping the next generation of engineer-entrepreneurs to nab opportunities.

A lot has changed at McGill since Robert Walsh (BEng'65) attended university 55 years ago. "When I go there now: wow!" he says. "The old machine shop is full of computers. When I was a student, McGill had computers that took punch cards."

Another thing that has changed, thanks in part to Walsh's own generosity, is that the Faculty of Engineering now offers students opportunities to gain entrepreneurial skills and experiences. "I think it's wonderful," he says, referring to the resources that are available through Engine, the Faculty's entrepreneurship and innovation hub.

Even though he has founded two successful companies, Walsh laughingly admits that he never thought of himself as an "entrepreneur" until he won the Ernst & Young Quebec Entrepreneur of the Year Award in 2002. This was 33 years after he began his first business, Walsh Automation, to assist industrial plants to improve productivity and quality. "New industrial plants were being built around the world in this era. It was at this time that sophisticated automation was being installed in all sectors of manufacturing, so I saw an opportunity."

One day in 1990, a less expected opportunity came along: the Royal Canadian Mounted Police was looking to automate some of its forensic work. As Walsh learned, every firearm leaves unique markings on bullets and cartridge cases when it fires. No two guns produce quite the same pattern, even if they're the same model. At the time, ballistics experts were still hunching over microscopes, making a painstaking series of comparisons, one by one. "They just couldn't keep up with the volume anymore, mainly due to the exponential increase in gun crime due to the drug trade," Walsh recalls. "It was a fascinating problem, even though I didn't know anything about guns: nobody in our company did."

Walsh did, however, know plenty about capturing images and using them in automation. For instance, some of his company's systems caught flaws in products by taking images of each product as it moved down the production line. He decided to give the new challenge his best shot.

In order to develop a system Walsh formed a company called Forensic Technology in 1991. With the help of an experienced ballistician the company developed the Integrated Ballistics Identification System (IBIS). The IBIS systems are now installed in 1,400 law enforcement laboratories in over 80 countries. IBIS works quickly to bring up likely matches between projectiles, cartridge cases and guns—even if they were collected by different crime labs. "You've probably seen it if you've ever watched CSI," Walsh says.

He sold Forensic Technology in 2014, but it remains a leader in its field to this day. "IBIS turned out to be such an interesting project," he says, "and a rewarding one, too. We'd hear about the results it was getting all of the time in news articles." The IBIS system has revolutionized how gun crime is now investigated worldwide.

Walsh believes that engineers need a broad skill set so that they can be flexible in their careers and seize opportunities to make a difference. Because of this, he has gifted McGill's Faculty of Engineering with flexible seed funding to promote entrepreneurship. "A broad education is truly valuable," he says. "It allows you to figure things out and then say, 'Okay, what can I do next?'"

Engineering Across Generations

Alumni father and son Arthur and Mark Levine enjoyed successful electrical engineering careers. With Mark's sons now in engineering, we ask how talent becomes multi-generational.

What factors lead to someone becoming a successful engineer? Is it having the ability from a young age to solve technical issues—the engineering brain, so to speak? Or do influences, from schooling to role models to career opportunities, dictate how a person will succeed in the profession? When looking at the Levines, father and son, you'll win arguing either side of the nature-versus-nurture debate.

Take Arthur Levine, BEng'61, who would have not, when he was growing up, been cast as the engineering type. "I had no interest in cars and how things work." Not a tinkerer or a guy into engines but one whose interest lay in playing music—at one point he had to choose between studying the clarinet and going into electrical engineering.

He admits that he didn't completely know what studying engineering entailed. "In high school, I was in the math and physics program, and it was called pre-engineering. So, by default, when I went to McGill, I applied to Engineering."

Arthur's design career included automating industrial drilling and milling machines, toll booths on the Champlain Bridge and temperature gauges on a naval destroyer. He learned emerging computer technologies for projects and, in 1969, began teaching them at the newly opened Dawson College, where he stayed for 12 years and consulted on the side. His side work became a manufacturing business, with partner Harvey Kofsky, its most successful products being a muscle stimulator and a photocopy counter.

Arthur credits McGill for having given him a grounding in solving a diversity of problems. "Once you know the basic principles of designing logic systems, it's only a matter of learning the latest technology to implement them."

Creating Solutions Across Generations

Arthur says his son, Mark Levine, BEng'91, although surrounded by technology and having a father who answered all manner of questions, was a natural, never needing to pore over manuals like he did.

Mark's foray into technology came through his first encounter with a personal computer. "The TRS-80 came out from Radio Shack and my friend got one. I saw for the first time that you could write software, store it on a cassette, load it into this box and make magic. That was it," says Mark.

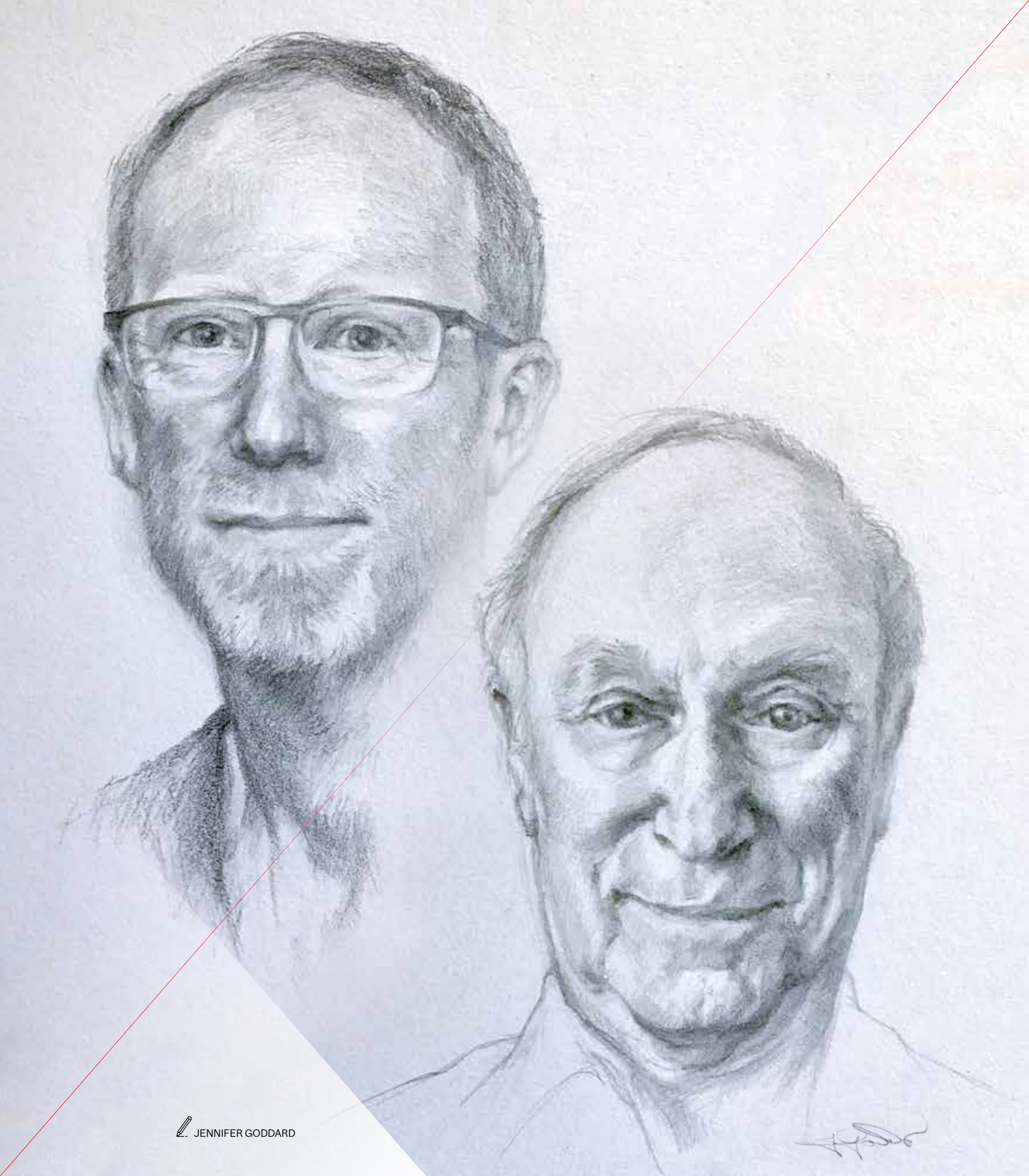
At 15, after having badly injured two fingers thanks to a folding ping pong table, he used all his time to write software. Meanwhile, his father's company, Copitrak (named for the photocopy counter), welcomed his computer knowledge. Kofsky, his father's partner, was writing code and began mentoring Mark, who knew then he would continue in the software field. He enrolled in Electrical Engineering with a minor in Computer Engineering and, during his studies, convinced a few professors to count what he was doing at Copitrak as legitimate course work.

Mark says his career developed in almost perfect five-year increments. After graduating in 1991, he took a greater role in the company, producing a fax equivalent to the photocopying counter. Five years later, he became the product manager and when Kofsky retired in 2002, Mark and Arthur ran the business. By 2007, he took over the company, which was sold in 2012, with him staying on until early 2018. He's now working with a cybersecurity start-up.

Mark spent almost three decades using his engineering talents to build solutions in customer service, product development and the manufacturing process. Similar to his father's assessment of his own career, he boils it down to a simple recipe: "My career has been about solving hard problems."

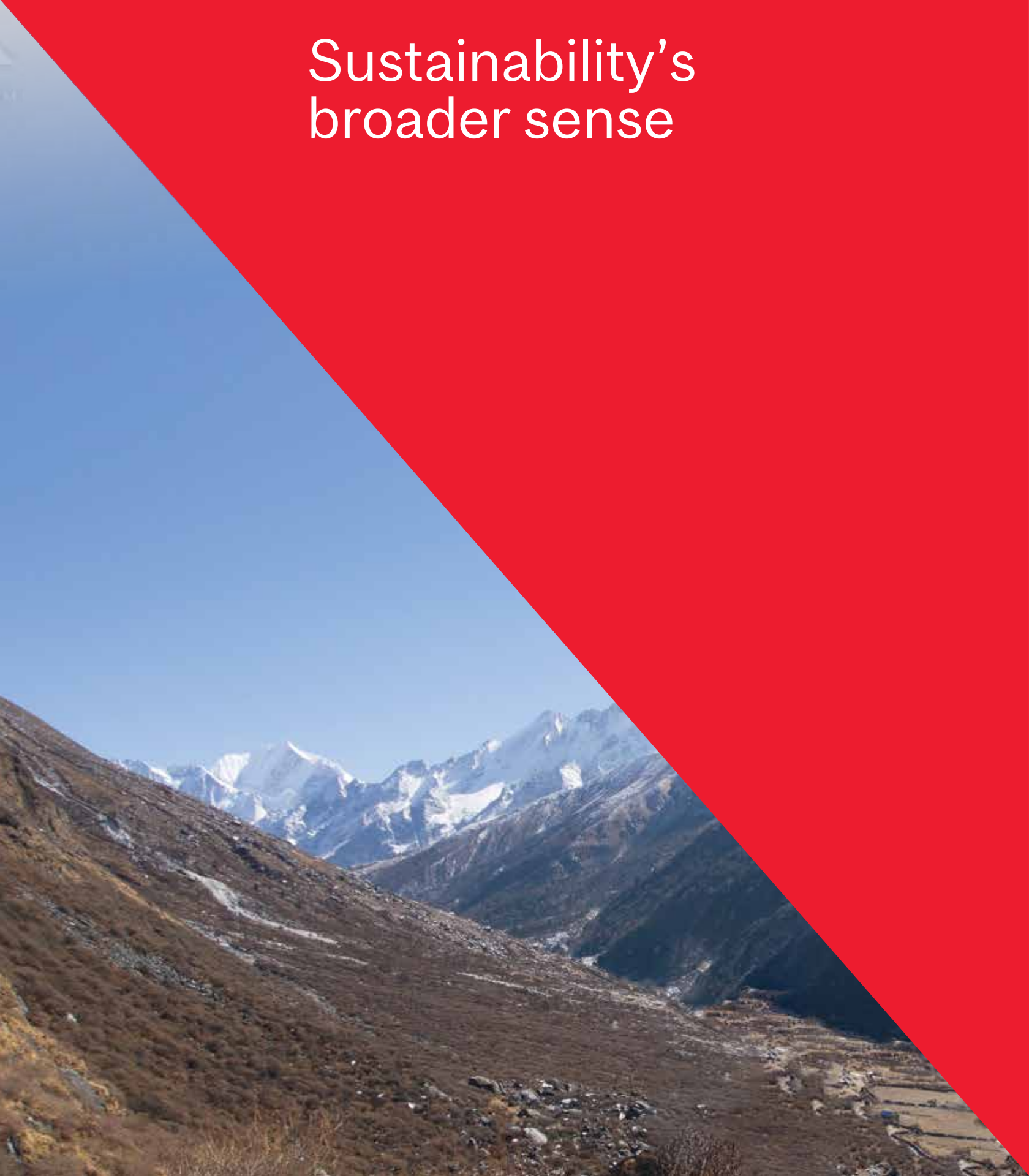
Both Arthur and Mark have been very active donors to the Faculty. The Arthur Levine Fellowship is awarded to a graduate engineering student doing work in the field of health. Arthur also established the Arthur Levine SURE Award in electronics, and computer hardware and software. Meanwhile Mark's Innovation Fund, and his activity as judge for the TechAccel grants, focuses on inventions. He also volunteers his time with Associate Professor Nate Quitoriano (Dept. of Mining and Materials Engineering), as a facilitator in his GoLead program, and Professor Michael Avedesian, helping to mentor students in his Technology Business Plan course.

Father and son, both grads from the Department of Electrical and Computer Engineering, are now watching the burgeoning of a third generation of engineers, with Mark's eldest son having graduated with honours from software engineering and his two younger ones currently enrolled in Aerospace and Bioengineering. Now, did their engineering talents come naturally or were they nurtured by the two previous generations? Perhaps the truth is somewhere in the middle.



JENNIFER GODDARD

Sustainability's broader sense



2020 has shown us how closely connected we all are. The future and prosperity of human society depends deeply on how we learn to live sustainably and responsibly.

Sustainability—climate change and beyond—touches every facet of our lives, and is a key priority at the Faculty and the University, as we move into McGill's Third Century. We thank our donors for championing the cause of sustainability, and for their commitment to helping the next generations create a better and cleaner world.

Ivey Foundation President Dr. Bruce Lourie says that universities have a vital role to play in leading the global conversation on climate change.

IVEY FOUNDATION

The Sustainability Advocate

The broad challenges posed by the climate change crisis demand an equally broad response embracing education and public policy as well as research, argues Bruce Lourie.

Dr. Bruce Lourie, President of the Ivey Foundation, which focuses on integrating the economy and the environment, moderated this year's virtual Seventh Annual Trottier Symposium on Sustainable Engineering, Energy and Design, titled "Lessons from a Pandemic: Solutions for Addressing the Climate Change Crisis."

How did you become a sustainability advocate?

As a student, I worked three summers for a mining company in northern Manitoba and was shocked that all of the effluent got dumped into forests and lakes. So my master's thesis in Environmental Studies at York University focused on the environmental impacts of mining in northern Canada. I then started my own environmental consulting company in 1992.

How do you define sustainability?

The traditional notion of sustainability is a compromise between economic, social, and ecological issues. Picture a Venn diagram, and the point at which all three intersect is sustainability. But the reality is that everything happens within an ecological framework. So really, there's one big circle, and that's the environment. Within the environment, we have society. And the economy is just a social construct within society. The whole concept of sustainability was wrongly conceived 40 years ago, set up as a compromise or dynamic between those three. We realize that we're now pushing up against the ecological barriers that make society possible—climate change is an obvious example.

You had a major role in phasing out coal plants in Ontario. How did you do this?

While working with energy utilities and environmental groups in 1995, I realized, when reading studies on the contributors of acid rain, mercury pollution, urban smog, climate change, various air toxins, that coal plants were always there. So I said, why don't we work on phasing out coal? Because it was hard to motivate people around environmental issues, we identified a connection between coal plants, air quality, asthma and health in general. We shifted the environmental issue to a health issue. There was also an economic element, as the health care system was paying for people with respiratory problems, and we advocated for renewable or cleaner sources of energy. Once all that got packaged together and the campaign made politicians and the public aware, it just became a matter of timelines and sequences. So never let anyone tell you that something can't be done! It's just a question of figuring out how best to do it.

How can universities address the challenges of sustainability?

We need better science education. If you don't have a rudimentary understanding of how physical systems work, where water comes from, how air gets purified, how plants grow, how energy transfers through ecological systems, then it's very hard to understand the problems we're facing today. We need to provide better science education across the curriculum, including courses tailored for arts or business students. And just as non-scientists need to learn about science, engineering and science students need to understand public policy. We need public policy to drive change. Engineers are working on solutions to most of the problems related to climate change, so technology isn't the issue. We just don't have the policies in place. In Canada, we're pretty far down the list of countries that are adopting electric cars. Look at the adoption rates in Scandinavia, Japan, South Korea, and the policies in those countries, as well as in California, where half of all American electric vehicles are sold.

In addition, students need exposure to different ways of thinking about sustainability issues, whether on the creative engineering side of problem solving, or the legal or public policy sides. When you're trying to solve these big problems you need a broad understanding of how all the pieces fit and how they affect different communities.

Can you tell us about your experience working with the Trottier Institute for Sustainability in Engineering and Design on this past fall's Trottier Symposium.

It was a real honour for me to be part of the Trottier Symposium, because I know Lorne Trottier very well and respect him tremendously. He's one of the most dedicated, generous philanthropists in this country, and passionate about climate change. And the panel itself and everyone I worked with at McGill was great. I do a lot of these sorts of things, and this one was certainly among the top.

Imagining a Future for the Land Left Behind

In the decades ahead, climate change will force millions of people to move to higher ground. According to Professor Rosetta S. Elkin, landscape architects have a valuable role to play in the transition.

Whenever Rosetta S. Elkin visits a landscape, she imagines what it could become. "Projecting into a future that doesn't yet exist is part of being a designer," she says. As an Associate Professor in McGill's Peter Guo-Hua Fu School of Architecture, she encourages students to do so with optimism.

A true interdisciplinarian, Elkin has degrees in fine arts, landscape architecture and history. Through it all, she has been fascinated by plant life. "I want to elevate the relationship between humans and plants," she says. "I want us to know them better. For instance, their remarkable capacity to withstand disturbance—and sometimes even thrive on it—is inspiring. Plants can give us cues about the future, because they've been adapting to changes for millions of years."

When it comes to humanity's potential for adapting to climate change, Elkin's optimism has found fertile ground in the concept of "retreat," which she defines as a deliberate, pre-emptive move from chronically risky areas to safer ones. Enabling retreat goes beyond merely relocating people, she explains, because it respects their relationships to the environment, including the land from which they're moving away.

Elkin has visited communities all over the world that have chosen retreat. One of them is close by: Sainte-Flavie, a Québécois village on the edge of the St. Lawrence River. The provincial government is providing subsidies for residents who live on the eroding, flood-prone shoreline and who want to move out of harm's way. Meanwhile, the village is building a new inland street they can resettle on.

For her part, Elkin is thinking about what will happen on the riverbank. "When I approached Sainte-Flavie, I said that one of the ways we could honour the move is to do something with the land left behind," she says. "Instead of just leaving empty foundations, let's make a park, a public waterfront. It helps people when they know what they're giving up their land for." The citizens of Sainte-Flavie agreed to participate in a pilot project with Elkin, who will be partnering with them to transform what is now a sandy, grassy landscape into a coastal forest with public walkways. "The new trees and plants should allow the town to hang on to more soil in the long run," Elkin explains. The work is slated to begin in May 2021.

To share case studies of retreat from history and her travels, Elkin is planning a book and a travelling exhibit. "I want to help communities learn from others," she says. "A town in Japan could take inspiration from what people did in a town in Quebec, which in turn could learn from a town in Virginia, and so on."

In the studios (classes where students put theoretical knowledge to hands-on, practical use) that she oversees at McGill, Elkin's students are designing ways to address climate-related risks in their own region. "They're engaging with real zoning, real changes and real land swaps that are unfolding in Quebec," she says. "And we're going to have mayors look at the student work."

Ultimately, Elkin wants humanity to think of retreat as a resilient option, rather than a defeat or a last resort. "It's a way of adapting to climate change," she says, "and that will be the challenge of our lifetime."

Professor Elkin conducting fieldwork in the Mediterranean island of Sardinia, Italy.

LAUREN D. GINSBERG

CATHERINE FORTIN

Elena Prioreschi (BEng'20) and Genevieve Shymanski (BSc[Arch]'20)'s research addresses how to heat homes more sustainably.

ANITA RAJA

Sustainability Takes Two

Two SURE Award funded undergrads work on a new kind of building design that could permanently change the way buildings are heated and cooled.

This year at McGill University, architecture and civil engineering teamed up to tackle a global problem: how to make a building more energy efficient. The carbon footprint of heating and cooling buildings is only going to increase as big cities across the planet continue to grow and develop, giving this project urgent relevance.

Assistant Professor Salmaan Craig, of the Peter Guo-hua Fu School of Architecture, has a novel idea: placing a house within a house. To test it, he recruits his two brightest undergraduates: Elena Prioreschi (BEng'20) and Genevieve Shymanski (BSc[Arch]'20). It fell to them in the last year of their undergraduate studies, in the midst of a global pandemic, to undertake this groundbreaking pilot study. "If this works, this is a huge deal," asserts Prioreschi. "This reduces the need for mechanical ventilation and air conditioning, which is a huge greenhouse gas emitter." With the prospect of putting their technical and design knowledge to better the world they live in, they began a long and iterative process to prove the feasibility of this deceptively simple concept.

Walls that Breathe

Prioreschi and Shymanski came up with a model of a room nested within another room, which uses a porous membrane, known as a "breathing wall" to separate both spaces. The wall includes a Thermal Active Surface which gently heats the air passing through it—a process which requires far less energy than traditional forced-air heating—and can be powered by solar or geothermal sources. Coupled with a natural buoyancy ventilation system—a passive method of moving air through their model—they successfully produced and reproduced a demonstrable heat recovery loop that could eventually be applied as a sustainable alternative to mechanical HVAC systems. "We saw success, which is very exciting!" remarks Shymanski, after recounting the issues they experienced after having to DIY a very sensitive visualization technique known as Schlieren Imaging, a method used for visualizing flows of heat and air that would otherwise be undetectable to the human eye. This kind of imaging was crucial in detecting the flow of heat along the "inner roof" of their model.

The harsh realities and restrictions of COVID-19 didn't dampen their spirits, and, as recipients of the Heather Monroe Blum SURE Award, they had the vital resources they needed to reach their goal. "As designers we have the creativity to take these concepts and find new ways to innovate them, and this project has so much potential in that respect," reflects Shymanski, a sentiment echoed by her colleague and now friend, Prioreschi. These two recent graduates are clearly optimistic and dedicated advocates for sustainable building practices. Ultimately, both describe the impact of this experience as a broadening of their intellectual horizons, and a valuable step in the pursuit of their careers after graduation. There can be no doubt that these are the kinds of mindsets and solutions the world needs right now.

Where Students Meet Sustainability

SEAM, which stands for Sustainability in Engineering At McGill, is an undergraduate student organization dedicated to the advancement of sustainable culture at the Faculty.

SEAM is the sustainability committee of the donor-supported Faculty of Engineering EUS (Engineering Undergraduate Society). It organizes a variety of projects and initiatives to further awareness of sustainability among students, including events and forums for discussing sustainability-related research opportunities.

Elena Prioreschi, who graduated this year with a Bachelor's degree in civil engineering, was involved with SEAM for three years. She started as a member and became steadily more involved until taking on the role of VP of Communications. "For me it was a slippery slope," she says, describing her quickly-developing passion for sustainability since joining SEAM. "It actually gets stuff done. SEAM has so many projects every single year. It shows students how to get involved in sustainability, and how to bring that into their careers." Inspired by her interest in pursuing sustainability consulting, Prioreschi set up a sustainability consulting panel with professionals representing many engineering disciplines—including electrical, mechanical and civil—to discuss the career opportunities available to environmentally-minded students. "Everything sounded like a dream job to me," she reflects.

SEAM has helped other Engineering groups and committees rethink their carbon footprint and improve their practices to a greater degree of sustainability. It initiated a successful test project in partnership with the McGill Office of Sustainability (MOoS) which implemented a composting system in the McConnell Engineering Building. Their efforts focused on marketing and facilitating the transition to the new system through training and teaching. SEAM has also reached into the classroom. "We had bi-weekly meetings with professors," recounts Prioreschi, "Seeing how sustainability can be worked into next year's syllabus. Some professors were on board with very little convincing, which is amazing. We saw some serious progress."

SEAM
Sustainability in Engineering at McGill

JUAN FERNÁNDEZ GONZÁLEZ. **M.H. WONG BUILDING.**

Urban Planning Professor Ahmed El-Geneidy researches how cities are changing with the global pandemic.

Remapping the Remote Work Reality

Professor Ahmed El-Geneidy looks at the post-COVID changes at the company office and how public transit will adapt

As countless numbers of people work and study remotely due to COVID-19 restrictions, School of Urban Planning Professor and Trottier Institute for Sustainability in Engineering and Design (TISED) member Ahmed El-Geneidy has been observing the effects that the current shifts in commuting and office relocation will have on the future of our urban landscape.

El-Geneidy believes some of the enormous changes that have ensued might remain in place and likely leave lasting effects on the downtown core of cities. He also wonders how companies will deal with their workforces and hopes that public transit authorities will stay nimble enough to serve those who most need their services, namely essential workers and those who can't afford a car.

"Some companies are going to say 'We don't need that big downtown office where we pay $20,000 a month,'" he says, adding that time will tell how many employers will take advantage of the benefit of a scattered staff. He's seen predictions that say 5% will drastically shift to a largely remote setup. But he says that employees may begin to ask for compensation for expenses they're incurring for their home offices or begin to cost the government more than it is willing to allow for tax deductions. There is also the lack of casual interactions and whether or not that is having a negative effect in less quantifiable ways. Will that lead some others to rethink the remote business concept? For sure the pandemic has accelerated the move to remote work for some companies who have been thinking about it for a while. The question remains, how many of these companies will continue to work remotely and save on rent and other operating costs.

Re-Designing the City

If it ends up that fewer people are working downtown, transit routes may need to be altered, says El-Geneidy. "We will have to start thinking, 'Do I still need a commuter train from the suburbs to downtown at high frequency or will I need more reliable bus service from low-income neighbourhoods to other industrial areas in the region?' We have to re-allocate the services in a certain way that actually serves those who need it the most." El-Geneidy explains that the sophisticated equipment that now tracks ridership, from infrared beams that count the numbers that get on and off a bus to the new AZUR subway cars' ability to estimate crowding through a weight read-out, is helping to give planners realistic data.

He says the COVID-19 crisis has shown transit authorities around the world that making sure essential workers arrive at their destinations is vital if a city wants to have its groceries on supermarket shelves and professionals arriving at their essential posts, even if that means transit authorities see budget shortfalls.

El-Geneidy, who is chair of the World Society on Transport and Land Use Research, says a robust transit system means investing in riders who don't have the luxury of staying home. "We have to put more money in public transit to make sure essential workers are getting to their destinations. We will wait and see what will happen to downtown and all its offices. But we might need to re-design parts of our transport network to serve the new reality."

Finding More Room in a Crowded Digital Space

Professor Tho Le-Ngoc calculates digital connection reliability and makes space for more and faster digital connections on our relatively limited bandwidth.

Digital connectivity has been key to so many of our daily encounters during this pandemic. Department of Electrical and Computer Engineering Professor Tho Le-Ngoc has been making sure the connectivity itself is functioning. A Theme Leader with hSITE (Healthcare Support through Information Technology Enhancements), Le-Ngoc uses various techniques to find more room on the Internet's bandwidth, ways for the growing amounts of data to travel more easily from one place to another.

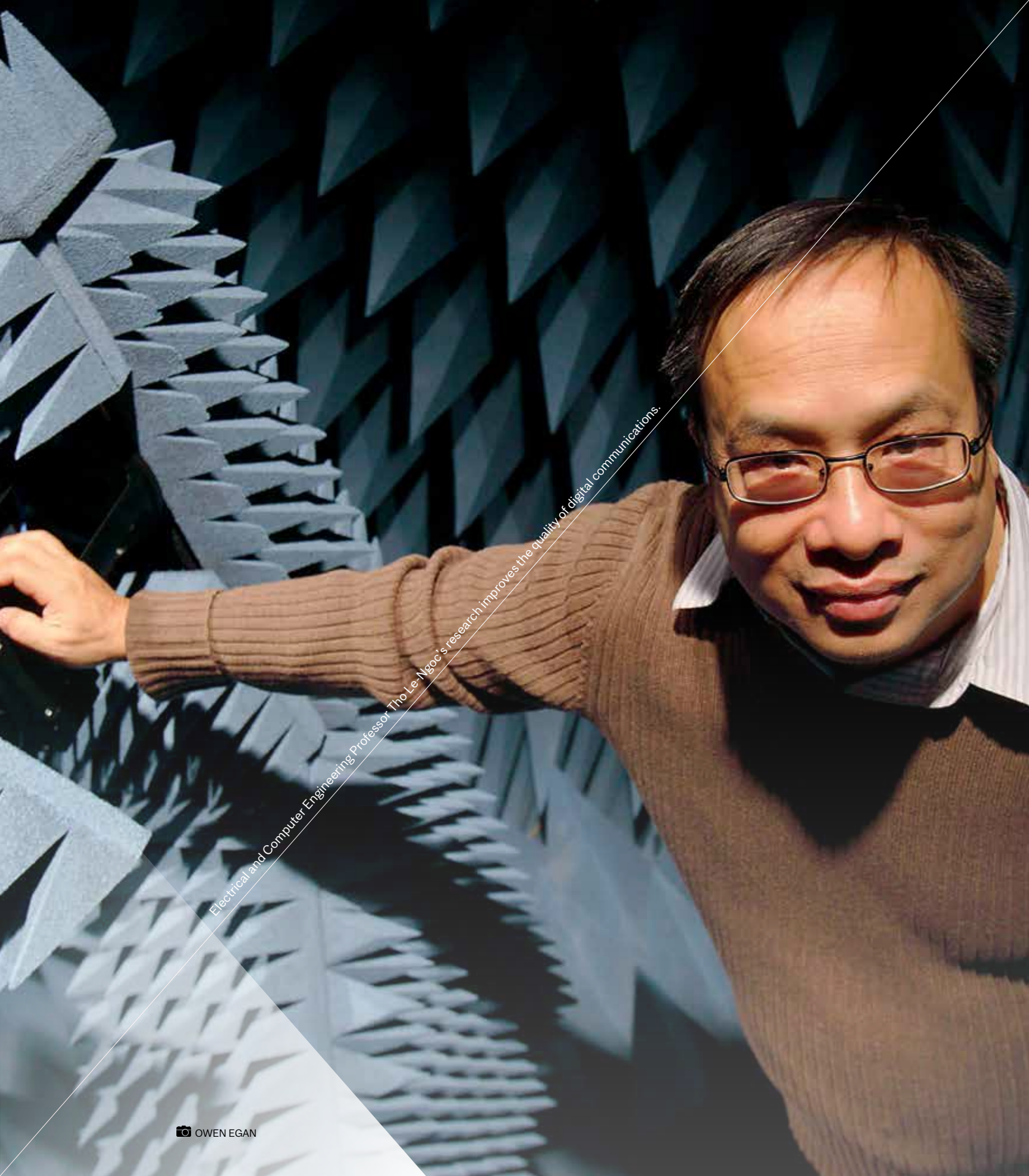
As massive amounts of talking including remote teaching take place online and work offices have relocated to dining room tables and den couches, the ability to connect through the internet has become increasingly important to the population. But the high-speed casting and receiving of signals is more limited than many of us might realize and Le-Ngoc is trying to make the tight space they're working in a little roomier. "With broadband, you're trying to squeeze as much information as you can into a limited bandwidth," he says.

Le-Ngoc, who holds the Canada Research Chair on Broadband Access Communications, says technological advancements, from increased sensors on cars to the ubiquitous street camera, as well as all the smart appliances around our houses that fall under the term "Internet of Things," have resulted in growing amounts of data looking to be shared. He says all that data strains its own ability to be transmitted and turned into clear and reliable images. "We want to have a connection with everything—the Internet of Things, sensors everywhere. That's why the capacity needs to be larger and larger. But you have a finite bandwidth."

The long-time researcher had made a name for himself when he had been part of the team that developed and designed the computer controls of a key tool for the NASA Space Shuttle and a point of pride for Canadians, the Canadarm, a robotic arm that helped astronauts manoeuvre payloads. Le-Ngoc focuses now on studying the spectrum that makes up the internet's bandwidth. He finds hidden frequencies in channels and unused moments in online exchanges to free up space, which he compares to desks being shared among employees who are in and out of an office. One of the ways he finds more space on the bandwidth is by estimating the number of connections between crowds of people making cellphone calls, texts and video calls. He then uses those probable bits of lost moments to shore up more space. He says the science of probabilities is becoming popular among those working in information communications technologies. "Probabilities has become the number-one course in communications."

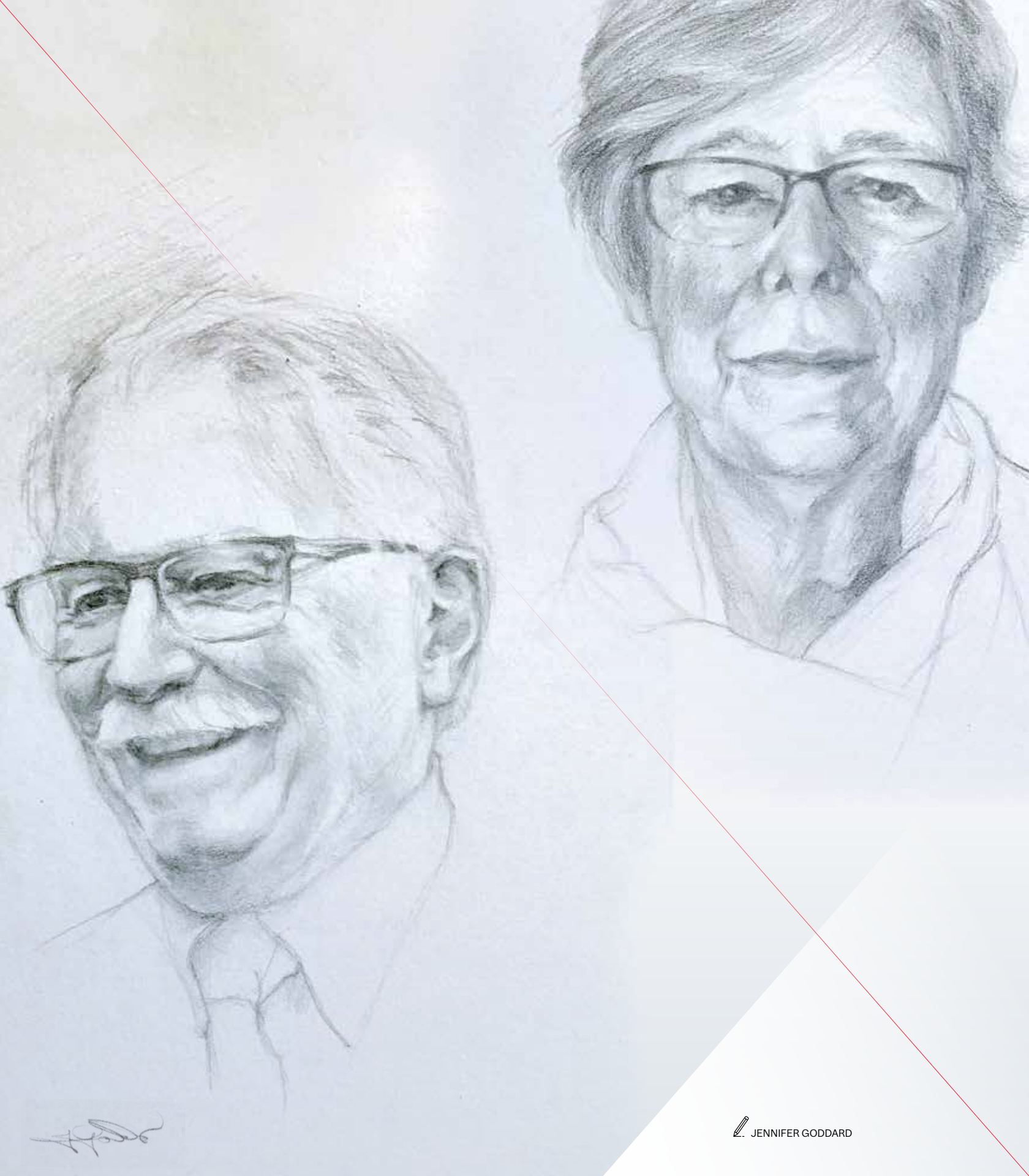
Those probabilities are creating a tiered system, says Le-Ngoc, where higher probabilities for clear connections will cost more, allowing for those working in an area like remote surgery to pay more for the clearer connections they need.

As our present and future desire for connectivity remains strong, Le-Ngoc will continue looking for new places to fit all that traveling data.



Electrical and Computer Engineering Professor Tho Le-Ngoc's research improves the quality of digital communications.

OWEN EGAN



JENNIFER GODDARD

Sustained and Sustainable Giving

Allan and Linda Stephens met at McGill back in 1967, and have been giving thanks ever since, with a focus on sustainability.

Allan Stephens (BEng '62) and his wife Linda Stephens (DipNurs '66, BN '67, MSc[A] '87), may have worked at two very different professions—Allan, an engineer in the energy sector and Linda, clinical nurse, teacher and administrator—but the Montreal couple are at one in their commitment to the Faculty's endeavours.

In 2013, the long-time donors established the Allan & Linda Stephens SURE Award in Sustainable Engineering and Design. It's a bursary given to deserving undergraduate Engineering students involved in research projects with the Trottier Institute for Sustainability in Engineering and Design, or working on issues of sustainability and design.

Sustainability was not part of Allan's work at Stephens Equipment, where he supplied compressed air technology to help avoid shorts on some of the massive electrical equipment used by the country's major hydro projects; nor was it part of Linda's work, practicing and then teaching nursing, and in her years as Director of Nursing Practice at the Montreal General Hospital. But it brought their differing perspectives together.

"I'd like to say that we had this great deep philosophical discussion over this," says Linda, tongue in cheek. "We do come at the world differently, for sure. Al has a scientific, very logical way of looking at the world, and I use those skills, but also have the caring component. To put the logic and the caring together is a nice mix of skills." She adds that sustainability is "not just a one-off kind of thing" and, with the climate crisis being such an important issue, they are hoping to see their common effort have a lasting effect.

For Allan, providing students with opportunities to do more research is especially important to him. He said he was fortunate as a student to be able to conduct research that touched on his work during summers at his father's equipment business (which he would eventually take over). "I can remember doing one paper where we were looking at diesel engine and fuel injection applications, because that tied in with what I was working on." He said others in his class did not have that same chance, which makes him and Linda happy to be giving to McGill Engineering.

McGill has always been important to them. It's where they met. It was 1967 and Linda was a student who had graduated from Toronto Western Hospital School of Nursing, but was excited by the opportunity to be in McGill's Nursing program for its more academic approach, with additional courses in sociology and psychology. Allan was part of a fraternity and "susceptible to distraction," but his having met Linda at a ski club cocktail party ("I didn't even ski!" admits Linda), proved to be a very lasting distraction. They've been married since 1968.

Giving back to McGill has continued, with regular donations, talks of future gifts and one special set of historical technical drawings that the couple recently gifted and now hang in the Faculty meeting room. The detailed hand-drawn lithographs, for machinery by the Morgan Engineering Company of Alliance, Ohio, were given to Allan's father from a US colleague in the heavy equipment business and date back to the 1880s-90s. With the couple's tradition of giving to the Faculty, it seems poetic that the Stephens would offer up historical drawings that speak of engineering's traditions.

Engineering Health Solutions

Hydrogel in tube: from the laboratory of Professor Noémie-Manuelle Dorval Courchesne

DANIEL MODAFFERI

The COVID-19 pandemic has reminded us that healthcare is a human right. Engineering's technological innovation and problem-solving play a key role ensuring global access to quality healthcare.

Our health is certainly our most valuable possession, and the global pandemic reveals how fragile it can be, both individual and collective. The Faculty of Engineering and McGill University are committed to ensuring and supporting healthcare globally. We thank our generous alumni for supporting research that saves and improves people's lives.

Chair of the Department of Bioengineering Professor Dan V. Nicolau educates a new and forward-thinking type of medical professional.

OWEN EGAN

Bioengineering and the Future of Medicine

From organic computers to biomimetics and synthetic biology, bioengineering may sound like the stuff of science fiction—but it could very well be the future of medicine, argues the Marika Zelenka Roy Chair in Bioengineering Professor Dan V. Nicolau.

We often think of the future in terms of the technology it will bring, imagining how our lives will be altered by interactions with new machines. Professor Nicolau, chair of the Department of Bioengineering, is himself working on a biocomputer, which will be able to make calculations that an electronic computer can't. It will not however replace the "old" electronic computer, as new technology almost always integrates the previous: "If you take nuclear power," explains Nicolau, "You have the nuclear reaction that generates heat. With heat you make steam, an old style technology. Then, with steam you turn a turbine—to make electricity."

Bioengineering, a relatively new field, applies the engineering approach to biological problems. As medical knowledge grows, and the use of artificial intelligence and robotics in healthcare become more widespread, bioengineering is expected to play an increasing role in healthcare practices. "Medical doctors now have been pushed harder, by a tsunami of gizmos and software to be essentially trouble-shooters navigating an increasingly vast body of knowledge based on prior experience," explains Nicolau. "Despite popular belief, engineers do react to events, understand what happened and predict with precision what will happen. Everything that happens around us has a cause. Science goes back in time to find these causes, leading to effects. Engineers go the other way, 'into the future' and start when the cause is reasonably, reproducibly known to create designs delivering desired functions with reasonable certainty. This is why 'design' is the cornerstone of engineering: engineering is poesis: we design stuff, be that devices, materials, processes, and soon biology."

Bioengineers employ physics, chemistry and information theory to understand the human body and other organisms as machines, fixing, or even improving them when something goes wrong. Technological innovation is certainly central to bioengineering: one day a robot will surely be a better surgeon than a human. What is more important, says Nicolau, is creating a class of people who combine a solid knowledge of biology with the engineer's creative spirit. The kind of graduates he and his colleagues are training at Department of Bioengineering, whose first undergraduate cohort graduated in 2020. They are able to go and apply their talents across a wide range of fields. When Professor Nicolau first meets a new cohort of students he tells them that there is good and bad news about future employment for bioengineers: the bad news is that half of the industry that they will work in does not yet exist; that is also the good news: they will have to go create it.

"Preparing humans for medical practice is almost certainly more important than making new materials or gizmos," says Nicolau, considering this his last major goal before riding off into the sunset of retirement. "It will be difficult, but they will be the best doctors in town."

Smart Clothing

Professor Noémie-Manuelle Dorval Courchesne is working on creating interactive electronic clothing: "smart" clothing that will respond to the wearer, be custom-tailored to improve health, and fabricated or enhanced with sustainable biomaterials.

Imagine wearing a jogging tank top that smells like flowers after being soaked in sweat, or rock-climbing pants that self-heal after an accidental tear. A patient with diabetes might wear a shirt with a biodegradable, bio-sensing patch, which could monitor blood sugar levels and detect dehydration or skin-related infections by measuring pH levels in sweat.

Biomaterials engineer and Assistant Professor in the Department of Chemical Engineering Noémie-Manuelle Dorval Courchesne is bringing each of these ideas for intelligent, eco-friendly clothing and accessories to life through cutting-edge research in her lab and forward-looking collaborations with industry partners such as Lululemon Athletica and Myant Technologies, a Toronto-based textile computing firm.

Inspired by Nature

"When we develop novel materials for biomedical applications, it's helpful to think about what consumers might want and wearable products that could expand healthcare access worldwide. Collaborating with industry allows us, as researchers, to understand their needs and the market for the materials we are creating in the lab. Interacting with companies like Lululemon has been very motivating for students in my group, as their guidance gives us a clear goal and vision for each project," says Dorval Courchesne, who is also a member of the Trottier Institute for Sustainability in Engineering and Design (TISED) and McGill Sustainability Systems Initiative (MSSI), and a 2020 recipient of McGill's Christophe Pierre Award for Research Excellence (Early Career).

Dorval Courchesne's own motivation and inspiration for creating sustainable materials with important functional properties relevant to textile, healthcare, electronics, and energy applications stems from the boundless possibilities for invention that she sees in nature.

"My motivation for this research comes from my interest in combining biology with engineering and a fascination for the building blocks that nature provides to fabricate materials. I look for inspiration from nature. Because nature has perfected and evolved proteins through many rounds of evolution over billions of years, it opens up many opportunities to assemble functional materials from proteins with novel properties such as harvesting light, conducting charges, and responding to environmental stimuli," says Dorval Courchesne, who honed her synthetic biology skills as a postdoctoral fellow at Harvard's Wyss Institute for Biologically Inspired Engineering.

Sustainability and Collaboration

Since joining McGill in 2017, Dorval Courchesne and her talented team of students have been developing protein-based materials to build biodegradable solar cells and bioelectronic devices as well. "I find it especially timely to apply synthetic biology tools to sustainability problems. Plastic wastes, electronic wastes, textile wastes, and global warming are grand challenges we are facing as a society. By looking at what nature has to offer, we can identify sustainable material alternatives and produce protein-based materials in the lab that have suitable properties for replacing or enhancing materials like plastics, textiles, or electronics," says Dorval Courchesne.

Smart, sustainable wearables could also be used to protect essential workers against infection from the coronavirus or another virus in a future pandemic. "We're interested in the idea of applying a protein with antiviral properties as a coating on personal protective equipment such as masks, gloves and lab coats to deactivate the virus," she says.

As a rising star in a fast-emerging field, Dorval Courchesne is thrilled to attract top students from Canada and internationally to pursue innovative, industry-relevant research on many fronts. Five PhD students in her lab are supported by MEDA (McGill Engineering Doctoral Awards). These include Daniel Modafferi, who is developing new bioelectronic materials for wearable and implantable electronic devices. "I wouldn't be able to support such a large team of graduate students at the PhD and Master levels without this generous funding from donors. It's great to have access to high-calibre students to bring forward and accelerate the development of new projects," she says.

"Assembling new materials at the nanoscale requires technical skills and knowledge, but also a lot of creativity, which I enjoy. My students are always involved in brainstorming activities, and I encourage them to think broadly and creatively about research questions. Through industrial collaborations, they are also exposed and given opportunities to solve real-world challenges."

DALIA JANE SALDANHA. PROTEINS ON TEXTILE.

Chemical Engineering Professor Noémie-Manuelle Dorval Courchesne makes smart clothing that can have medical uses.

Start-up Haply Robotics, co-founded by Colin Gallacher (BEng'13, MEng'16), is the winner of the Code Life Ventilator Challenge.

FELIX DESOURDY

Colin Gallacher and Haply Robotics

From creating award-winning inexpensive ventilators to virtual reality simulations that reproduce the touch as well as the visuals of surgery, Haply Robotics is a rising force.

When Haply Robotics submitted its prototype to the Code Life Ventilator Challenge launched by the Montreal General Hospital Foundation in April 2020, the team felt they had a winner. “It was a perfect fit for us,” says Haply co-founder and McGill Mechanical Engineering graduate Colin Gallacher (BEng’13, MEng’16). “We're a small team with expertise in areas we're very passionate about, and we have enough of a chip on our shoulder to really want to succeed.” Succeed they did: in December 2020 Haply’s ventilator was announced the Code Life winner, beating out hundreds of entries worldwide.

Haply was formed in 2017 to develop Gallacher’s graduate research into 3D surgical simulations, which won the Ian McLachlan Prize for Entrepreneurship in Engineering. “That award instilled in me the belief that I was on the right path,” he says. “I put the prize money into product development, buying 3D printing and electronics equipment.” Today Haply is producing simulation programs based on his research, among other products. “The surgeon works in a 3D virtual environment, with controllers that give them a sense of the forces they would feel when drilling, cutting or suturing.”

Gallacher’s interest in medical technologies has deep roots. “I grew up in the Middle East and on Saipan, in the Marianas Islands,” he says. “Once you’re thirty minutes away from major centers in some parts of the world, you don’t have access to health care.” He has also travelled with his physician parents on some of the medical teams they have led to South America, where they perform surgeries in regions with little access to medical equipment. Consequently, the Haply ventilator is open-sourced, inexpensive and easy to build and maintain, and the company is working with manufacturers to ensure that it is available where it is needed, targeting places with limited health care resources. “Everybody on our team has contributed to this project in huge ways. One team member’s first baby was born several months premature at the start of the pandemic and has been on a ventilator almost ever since,” he says. “The child is doing much better now, and that's been a hugely powerful motivation. It has made this project very personal.”

haply

First Layer of Defence

McGill researchers in the Department of Mining and Materials Engineering are testing an innovative antiviral coating that protects against COVID-19. PhD candidate André Liberati explains the project.

With the COVID-19 pandemic still wreaking havoc across the globe, governments and private corporations are looking for any and every means possible of controlling and ultimately eliminating the spread of the disease. In response, a pilot project led by Professor Stephen Yue of the Faculty of Engineering was launched promising a one-of-a-kind solution to the problem: applying a metallurgical antiviral coating to high-contact surfaces. Due to his position as a PhD candidate in Materials Engineering in Professor Yue's lab, André Liberati has become an unofficial spokesperson for the project. Liberati recently appeared remotely in a segment on the TVA Nouvelles television program to discuss it.

The science behind the pilot project relies predominantly on advances in cold spraying techniques—the process of applying metallic layers to objects—and the well-documented natural antiviral properties of copper. "According to Prof. Chen Liang who leads the virology studies, it's likely that copper deactivates the virus by attacking its genome," Liberati explains, and without a fully functioning genome the virus loses its function. Professor Yue's lab is studying the effect of cold spraying a layer of copper on high contact surfaces such as doorknobs and railings, passively protecting these areas and effectively disrupting the physical highways through which the virus spreads in high-risk environments such as hospitals, public transportation, and elder care facilities. "The results were even better than what we thought we would get," Liberati remarks. Within thirty minutes of contact with the copper coating, they've observed rates of 99.9% efficacy in deactivating the viruses they've tested.

Nevertheless, time is of the essence in this situation. "The collaborators on the project form a complete circle," explains Liberati. On the research side, there's McGill University and the National Research Council Canada (NRC). Then there are the corporate partners such as 5N Plus who supply the copper powders, and Polycontrols who integrate the cold spray process on an industrial level. Finally, the circle is completed with the consulting engineering firm Hatch Ltd., who are working to broaden the project's implementation. To Liberati, this collaboration on the part of university researchers, private companies and government investment in innovation gives the work an edge in terms of getting it out into the real world as soon as possible. This kind of synergy is something students in the Faculty can learn the value of through the McGill Engine, the Engineering Faculty's technologically-based innovation and entrepreneurship centre.

At 26 years old, André Liberati—a McGill Engineering Doctoral Award (MEDA) recipient—is deeply motivated by the prospect of his technical skills having such a direct and positive impact on the lives of others. Despite the promising results, he asks himself: "How can we make this better?" It is this spirit of innovation and collaboration for the public good, fostered at the Faculty, which produces the solutions we need today, and will need tomorrow, as we endeavour to beat the COVID-19 pandemic and solve major global problems.

Materials Engineering PhD candidate André Liberati is working to make surfaces safer, in a time of pandemic.

MICHAEL CARDILLO

Department of Civil Engineering student Sneha Singh (BEng'22) monitors the COVID-19 pandemic through wastewater sampling.

RANA TAHER

Tracking the Pandemic Using Wastewater

With support from a Summer Undergraduate Research in Engineering (SURE) award, this environmentally-minded undergraduate gained hands-on experience developing an early-warning system to monitor the spread of COVID-19.

When Sneha Singh (BEng'22) applied in February to train with Associate Professor Dominic Frigon (BSc'95, MSc'99) through the SURE (Summer Undergraduate Research in Engineering) program, she was eager to gain hands-on experience doing microbial testing in wastewater systems. She didn't however, anticipate working on a COVID-19 wastewater research project that could impact the health of Canada's entire population.

"It was exciting to be part of a research project that is so relevant. The idea is that by testing local wastewater samples you can monitor changes in the level of coronavirus infection for the entire population of an area. This could be used as an early warning system to detect community outbreaks because you would see spikes in concentration of the virus in wastewater before people develop symptoms and in asymptomatic people too," explains Singh, winner of the Furino-Remillard SURE Award in Sustainable Engineering for her project, "Detection of SARS-CoV-2 in Wastewater and Pilot-study for the Establishment of a COVID-19 Population Surveillance System in Canada."

McGill's wastewater researchers are tracking trends in viral concentration provincially and helping to build a national COVID-19 surveillance system through a project led by the Canadian Water Network. "To be part of such a large-scale project was eye-opening. It showed me the collaborative nature of research and the importance of working with other researchers across the country to tackle a big problem like COVID-19," says Singh, a fourth-year student in the Department of Civil Engineering. As a summer research assistant in Professor Frigon's lab, Singh collected and analyzed weekly samples from May through August from wastewater treatment plants in La Prairie and Cowansville, regions just outside Montreal, in order to assess the situation of Greater Montreal as a whole, comparing the densely populated city to less populated regions. "We worked on developing the best methods to isolate the virus and measure its concentration in wastewater. Since then, the team has tested wastewater in Quebec City and confirmed that increases in virus concentrations can potentially predict increases in COVID-19 cases a week in advance of public health data," she says.

She is grateful to be the recipient of an award that enabled her to develop valuable research skills and experience, and to also have an impact on a global health problem. "It's a great endeavour by donors to fund opportunities for engineering undergrads to do research that matters. This was a very cool project that made me consider a career in research for the first time," says Singh, who is specializing in environmental engineering and minoring in software engineering. "I could see myself applying those skills to wastewater modelling and surveillance to enhance wastewater treatment, or in a future pandemic."

The Value of Helping Others

Late alumnus Sal Furino viewed education as a precious gift that opened doors to a successful career and better life. As a tribute to his giving spirit, Joanne Remillard-Furino wishes to expand their support for education, sustainability and bioengineering research.

A higher education was the springboard to a brighter future for the late Sal Furino (BEng'72), who emigrated to Montreal from Italy at age six. As a civil engineering student, Sal had ambition and drive, fuelled by gratitude for the sacrifices his parents made to give him a chance for a better life. He fulfilled those ambitions and dreams through a highly successful, 40-year career, and had a strong desire to give back.

"Sal was a very giving, generous person, who people went to for help with their problems. He wanted to share his success with others," says Joanne Remillard-Furino, his spouse of 41 years.

"Sal was the youngest of four, and the first one in his extended family to attend university. He was a bright guy, who was very mathematically oriented, and engineering interested him. He wanted to make his family proud and their sacrifices worthwhile. They were very proud of him and rightly so," says Joanne.

Ambition and Perseverance

Sal and Joanne met after he graduated and had been recruited by H.J. O'Connell Ltd., a Montreal-based construction firm that served the mining and energy industries in Northern Quebec, Newfoundland and Labrador, and James Bay. "Ours was a long-distance relationship at first. Sal was a guy you could count on and he didn't give up."

His first project involved building the infrastructure for a new town, Fermont, near the Quebec-Labrador border, established to mine iron ore. "Sal had never left home before, and it was a big shock. He lived in a camp for two months before his first trip back to Montreal and it was rough. But he adjusted and was willing to go back," she recalls.

Sal persevered and had a great career with H.J O'Connell. He helped expand the firm into a large and profitable business, later sold to Bird Construction in 2011. "When the older partners retired in the 1980s, he became an owner with two colleagues. They were a very special group, who always made decisions together." He also worked for the Québec Cartier Mining Company, later ArcelorMittal, strip-mining at Mont Wright.

"Sal was proud of being a high-achieving student and grateful for the outstanding education he'd received. He was motivated to help the University and engineering students. They had a special place in his heart," says Joanne.

Enduring Ties

Sal maintained his ties to McGill, helping to organize a 25-year anniversary reunion for his civil engineering class of '72. He also mentored and championed a McGill civil engineering graduate, Anoop Singh (BEng'02), who took over his responsibilities after the sale.

When Sal retired, he established the Furino-Remillard Scholarship and Furino-Remillard SURE Award in Sustainable Engineering.

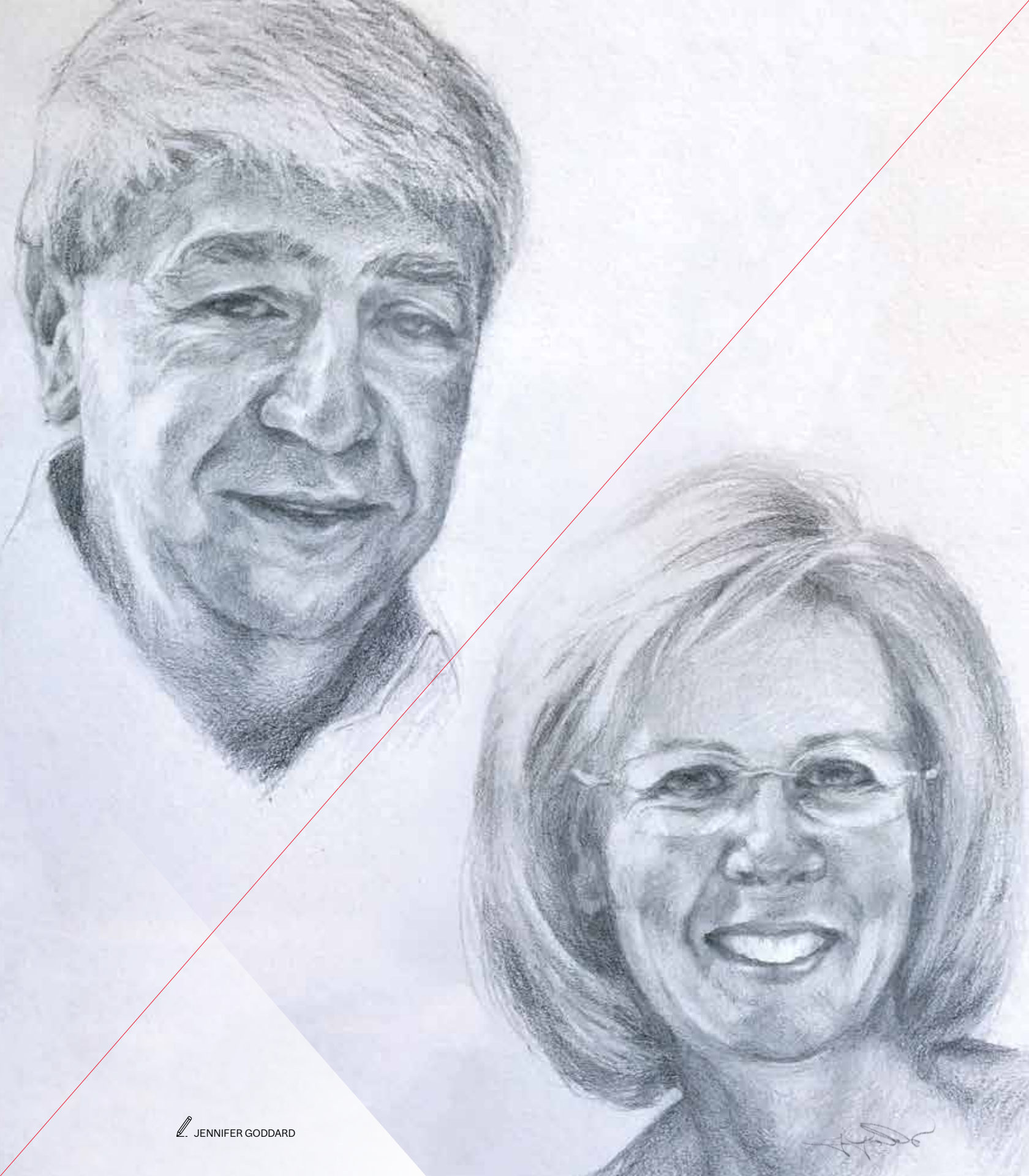
Sadly, he passed away in June 2017, after being diagnosed with pancreatic cancer 20 months earlier.

Joanne saw these gifts as his tribute to her. "I was touched and grateful that he put my name on the awards as well as his. I supported him while he travelled for work and I held the fort with the kids. He recognized the value of my work at home."

She is strongly supportive of education and research opportunities for students. "Since losing Sal, I've been directly involved and recognize the importance of funding health and sustainability research. My daughter Claudia and I met a number of the recipients and were impressed with their work," says Joanne.

The family is now paying tribute by setting up a philanthropic foundation in Sal Furino's name. "My children and I want to pay tribute to Sal and the kind of man he was. He was a great dad and husband. Sal saw the potential in other people and if he knew someone needed help, he would offer it without them having to ask. He was also a lot of fun. He liked to joke and tease people. He was a great dancer and we loved to dance," she says.

Joanne wants the gift in his name to be a legacy that will contribute to a brighter, healthier future for others. "Sal's life was cut short at 67. My family and I want to do something to spare others from that grief, sadness, and loss. We would like to encourage and support bioengineering research, which can help in developing new imaging techniques and tools for better diagnosis, and new treatments for cancer and other illnesses."



JENNIFER GODDARD

Faculty Benefactors

Implementing meaningful initiatives, developing life-changing innovations, conducting groundbreaking research: the one constant in all of these crucial activities is the involvement and contributions of our dedicated alumni. The following list recognizes individuals, corporations, and foundations who have made a gift of $25,000 or more to our Faculty since May 1, 2013

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Mr. Michael John Green (BEng'62)
Mr. Arthur C F Lau (BArch'62) and Mrs. Crystal Lau
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Mr. Nicolas Kauser (BEng'63) and Mrs. Judy Kauser
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Toyota Canada Inc.
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Urban Strategies Inc.
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Generous Benefactors Remembered

The Faculty of Engineering is profoundly grateful for the bequests, both large and small, that it has received from alumni and friends. Following is a list of bequests that the Faculty received through to the end of the last fiscal year, which ended on April 30, 2020.

Estate of Beatrice and Jason Waller (BEng'36)
Estate of Hugh Lamb (BEng'40)
Estate of John L Darby (BArch'41)
Donald Mooney Estate (BEng'47)
Estate of Paul Tudor (BEng'48)
Maurice Corbeil (BEng'55)
Estate of Livio DeSimone (BEng'57, DSc'94)
Estate of Henry E Golba (BArch'60)
Estate of Christian M Feise (BArch'65)
Estate of Sonya Ward

MADE by McGill

The Faculty at a glance: How your gift makes a difference

GIVING

6,641
INDIVIDUAL DONORS (INCLUDING ANNUAL FUND DONORS) SINCE 2013

217
MAJOR GIFTS SINCE 2013

23
CHAIRS, FACULTY SCHOLARS AND PROFESSORSHIPS WERE SUPPORTED

PHILANTHROPIC IMPACT IN THE 2019-2020 ACADEMIC YEAR

243
STUDENTS WERE SUPPORTED BY SCHOLARSHIPS

220
STUDENTS RECEIVED ENTRANCE SCHOLARSHIPS

69
DONOR-FUNDED SURE TRAINEESHIPS WERE AWARDED

334
STUDENTS RECEIVED BURSARIES

151
DONOR-FUNDED FELLOWSHIPS WERE AWARDED

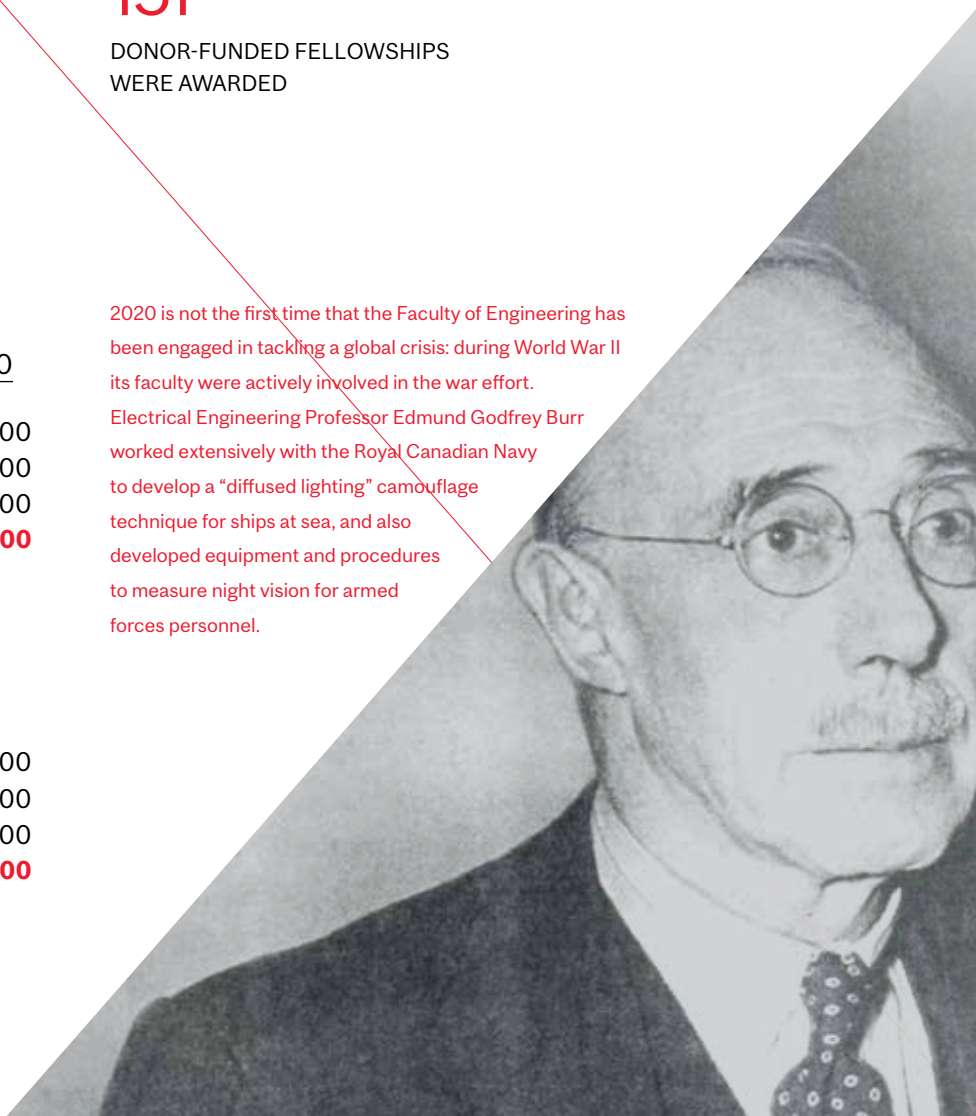
FUNDING DISTRIBUTED TO UNDERGRADUATE STUDENTS IN 2019-2020

Undergraduate Scholarships	$1,420,175.00
Undergraduate Bursaries	$3,480,081.00
Undergraduate Research	$779,627.00
Total	**$5,679,883.00**

FUNDING DISTRIBUTED THROUGH THE MEDA PROGRAM IN 2019-2020

University provided Graduate/ Postdoctoral Studies funding	$3,480,081.00
Faculty donor funding	$1,180,122.00
Supervisor funding	$3,178,087.00
Total	**$7,838,290.00**

2020 is not the first time that the Faculty of Engineering has been engaged in tackling a global crisis: during World War II its faculty were actively involved in the war effort. Electrical Engineering Professor Edmund Godfrey Burr worked extensively with the Royal Canadian Navy to develop a "diffused lighting" camouflage technique for ships at sea, and also developed equipment and procedures to measure night vision for armed forces personnel.



THE FACULTY TODAY

160
PROFESSORS

6
DEPARTMENTS

- Bioengineering
- Chemical Engineering
- Civil Engineering
- Electrical and Computer Engineering
- Mechanical Engineering
- Mining and Materials Engineering

2
SCHOOLS

- Peter Guo-hua Fu School of Architecture
- School of Urban Planning

3
INSTITUTES

- Trottier Institute for Sustainability in Engineering and Design (TISED)
- McGill Institute for Aerospace Engineering (MIAE)
- McGill Institute for Advanced Materials (MIAM)

8
RESEARCH CENTRES

- Centre for Intelligent Machines (CIM)
- Brace Centre for Water Resources Management
- Systèmes, technologies et applications en radiofréquence et communications (STARaCom)
- McGill Metals Processing Centre
- Plasma-Québec (Plasma Processing Laboratory)
- COSMO – Stochastic Mine Planning Laboratory
- McGill Aerospace Materials and Alloy Development Centre
- Yan P. Lin Centre (with Faculty of Arts)

GRADUATE PROGRAM DEMOGRAPHICS

1,106
GRADUATE STUDENTS

59%
INTERNATIONAL STUDENTS

23%
STUDENTS FROM QUEBEC

18%
STUDENTS FROM THE REST OF CANADA

34%
FEMALE STUDENTS

UNDERGRADUATE PROGRAM DEMOGRAPHICS

3,448
UNDERGRADUATE STUDENTS

48%
STUDENTS FROM QUEBEC

33%
FEMALE STUDENTS

Thank you!

And please keep safe.

McGill | Faculty of Engineering

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