Sinai Health Foundation

Spring/Summer 2022

TRANSFORMING CARE THROUGH RESEARCH

Your impact: A report to Lunenfeld-Tanenbaum Research Institute (LTRI) donors

A message from Dr. Stephen Lye

Dr. Stephen Lye, Interim Director, Lunenfeld-Tanenbaum Research Institute

As I write this message summer is just around the corner, COVID-19 restrictions are mostly lifted and we are looking cautiously toward a more normal season.

That's why I am so grateful to you, Sinai Health's community of generous donors, for helping drive advances across the Lunenfeld-Tanenbaum Research Institute (LTRI). Your support is so critical to our work. On behalf of all of us, thank you.

In this report we introduce you to three outstanding scientists who each bring different expertise to the table. Mei Zhen is a neuroscientist who recently published a landmark study 30 years in the making about how the brain develops; Anne-Claude Gingras' expertise is in using proteomics tools to better understand how the human cell is organized, which she applied to COVID-19 research during the pandemic; and Kieran Campbell is an early-career scientist conducting cutting-edge research in machine learning and artificial intelligence.

In many ways, these three reflect science. Scientific discoveries require a range of expertise and a diversity of backgrounds in an institution in order to derive new knowledge about human health and disease, and translate it to improved patient care.

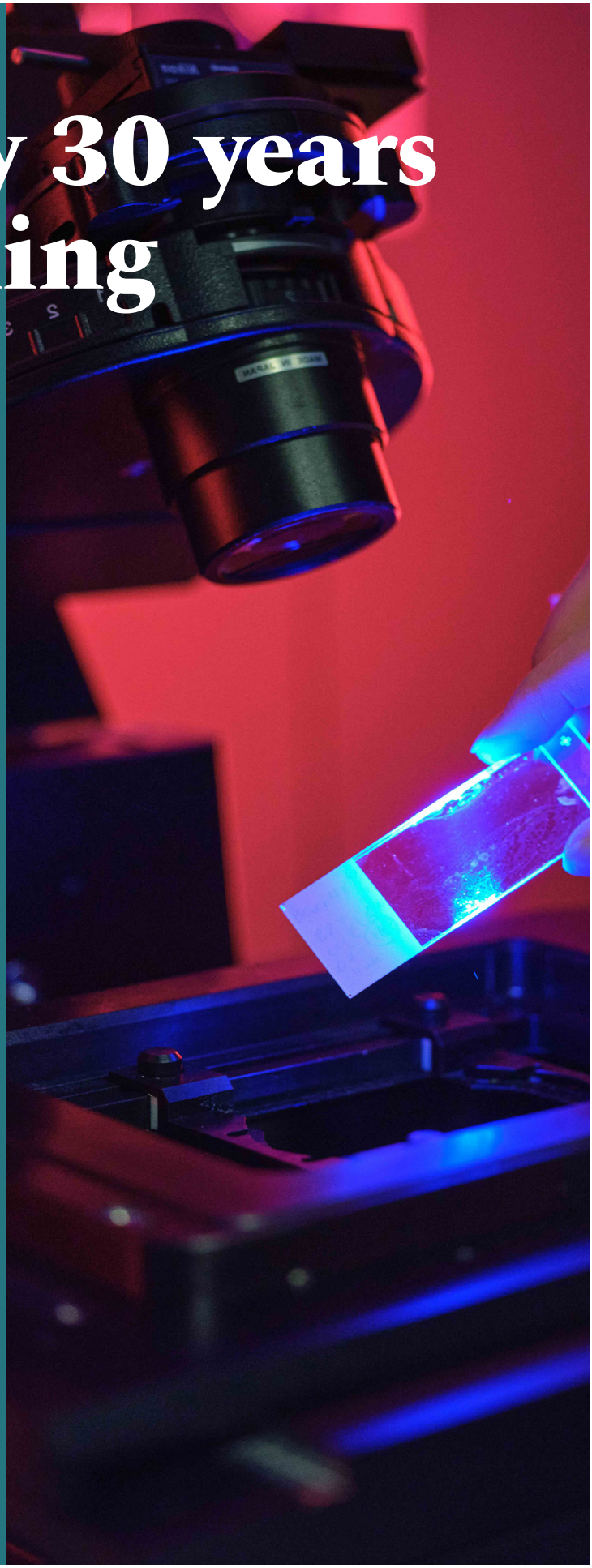
I am proud to feature two of our female leaders, who are leading new discoveries and acting as role models to young trainees in medical science.

I hope you will enjoy reading this report, which details the incredible impact of your philanthropy. Every breakthrough described was made possible thanks in part to generous donor support for the LTRI. You are powering discoveries that are changing our understanding of human health.

Thank you for your unwavering support during the immense challenges of the past few years. We couldn't have done it without you.

A discovery 30 years in the making

When she was five years old, Dr. Mei Zhen told her father she wanted to be Marie Curie when she grew up.



Curie, the trailblazing chemist and physicist, emigrated to Paris from Poland in 1891, facing roadblock after roadblock in a male-dominated field long before the term even existed. She went on to become the first woman to win the Nobel prize and the only to do so twice, inspiring Dr. Zhen to apply herself and work hard to overcome obstacles.

That's exactly what she did. Last year, a team led by Dr. Zhen at Sinai Health used a tiny model to accomplish a big breakthrough in neuroscience.

Using advanced imaging developed by Dr. Zhen and her collaborators to peer inside the cells of a tiny worm-like animal model called *Caenorhabditis elegans (C. elegans)*, Dr. Zhen's team was able to track how an animal's brain changes throughout its lifetime. By looking at the brain as a whole rather than as individual structures and processes, this approach sheds new light on how human brains develop.

The road to *C. elegans*

Dr. Zhen was first introduced to the *C. elegans* model at a conference while working on her PhD in biochemistry at the University of British Columbia. Instantly fascinated, she made the decision right then and there. "I said, this is exactly what I want to do for my postdoctoral work."

The pursuit of mapping the *C. elegans* brain brought Dr. Zhen to UC Santa Cruz, where she credits having an amazing mentor for her success. But the science wasn't perfect. They were looking at processes in smaller parts of the brain and used those findings to make assumptions about the rest of the brain – similar to how we might make statistical inferences based on small sample sizes.

"It posed a bigger question," Dr. Zhen explains. "If we want to get the big picture we cannot just study one gene at a time, one neuron at a time, or one connection at a time. We must check every single connection and every single neuron."

Dr. Mei Zhen

A new breakthrough

The only problem was that the technology simply didn't exist to do so. Dr. Zhen began collaborating with a team at Harvard to gradually develop electron microscopy, which is what her team uses today to automate processes that allow them to analyze the entire brain as it develops.

"When the machines became available, this small group of people who were talking about this work for so many years could now suddenly say, let's just do it, let's try it on a real sample. And we officially started testing our first sample in 2010."

Keeping the momentum

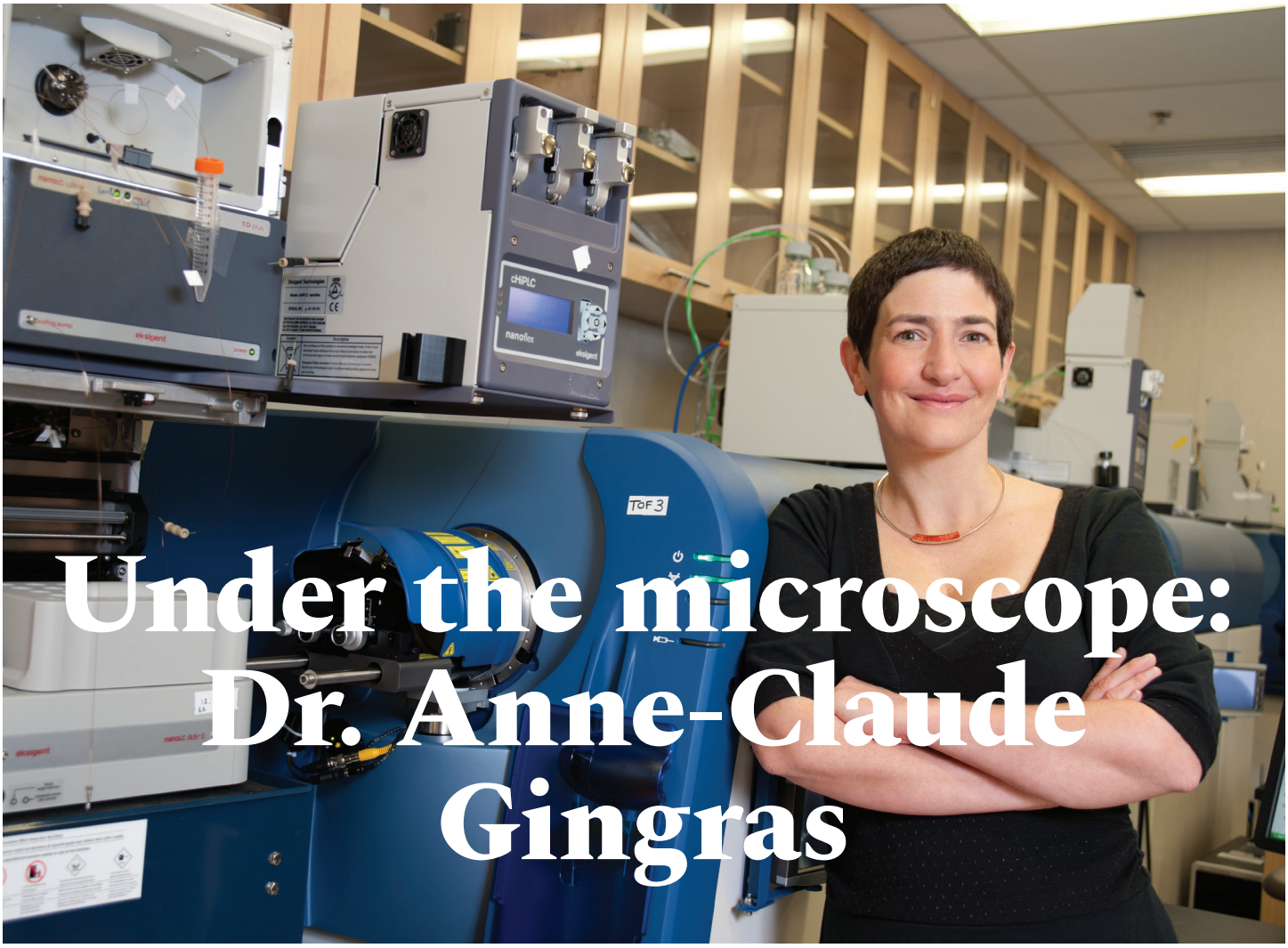
So what keeps someone like Dr. Zhen going through all that hard work over the years?

"Well there are many things," she says. "I get up every morning and I can't wait to start working. I do it not just for myself, but to contribute knowledge and resources that will benefit the entire research community. This work will lay down some fundamental understandings about how we understand life itself."

Her team also inspires her to keep pushing the envelope.

"I've found myself in the right place, at the right time, and with the right group of people to contribute as much as I can in my lifetime. I feel privileged and lucky."

When she isn't at work, Dr. Zhen still loves to read – something that has not changed since her Marie Curie days. "If I'm not doing natural, scientific writing or reading, I'm spending my time reading literature, hiking and dancing."



Under the microscope: Dr. Anne-Claude Gingras

Get to know one of LTRI's superstar scientists, whose love of laboratory science took hold one summer in a Montreal lab and never let go.

That love of tinkering with new ideas in the lab would eventually bring her to Mount Sinai, where today she is a leader in proteomics and COVID-19 research. Donor support for LTRI is helping her lab drive our understanding of the basic building blocks of life and human disease.

Could you tell us about your research focus prior to COVID?

Prior to COVID, my main research was to understand how proteins interact. How do they talk to each other to perform different activities? And how are these associations regulated in diseases like cancer and in rare diseases that affect children?

My lab develops cutting-edge technologies to determine the nature of interactions between the proteins within cells. Because we're developing these technologies, we collaborate with other researchers at LTRI and elsewhere. We serve as a hub for people to come and ask for help in using our technologies to apply to their particular areas of study.

How did you get started in this line of research?

How much time do you have? I always liked science, but I decided to do that as my job about halfway through my bachelor's degree.

The minute that I got a summer job in a laboratory, that was it! I just had so much fun asking questions. Suddenly, I realized, I can play and get paid for doing this. That's pretty awesome. So that's essentially what happened. Nothing in my life was ever planned - I got my start, wanted more, and dedicated myself to making sure that happened.

> “Nothing in my life was ever planned - I got my start, wanted more, and dedicated myself to making sure that happened.”
>
> **Dr. Anne-Claude Gingras**

What brought you to Mount Sinai?

I completed my postdoctoral degree in a lab in Seattle, where they were inventing new technologies to identify proteins.

That's what got me recruited to Toronto. They were excited by the fact that I would bring new expertise that I had acquired in Seattle with the technology, but also that the biology that I was interested in really fit well with what they were studying at Sinai.

What would you say is the most exciting aspect about your work?

I really like working with the trainees, the postdocs and the students. I love the excitement in their eye when they find something cool, and for the first few minutes, they know it before I even know it. Then they tell me about it and we get excited together. I think this is great, right? I think this is essentially why we still do research.

Tell us about the shift toward COVID research.

At the beginning of the pandemic, we knew we were facing a big problem. Because our hospital did so much screening, we wondered, is there any way that we can help with the clinical mandate of the hospital? We worked with the LTRI robotics team to do thousands of tests per day. We were getting great quality data.

How did that evolve over the pandemic?

We started working on some large scale collaborations, including working with the National Microbiology Lab in Winnipeg on testing blood samples for COVID proteins. We were also one of two labs that the COVID-19 Immunity Task Force gave the responsibility of doing the lab work for a Statistics Canada survey, which assessed the percentage of people who had been exposed to the COVID-19 virus in the first couple of waves.

Once we introduced vaccines, we became one of two labs in the country doing large scale antibody testing.

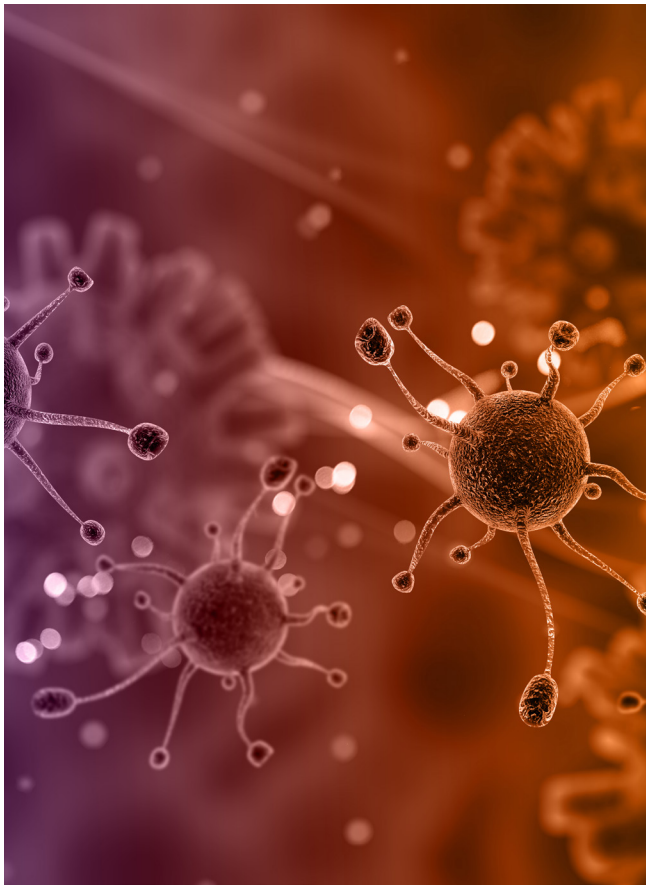
How about your hobbies outside of the lab? What do you like to do for fun?

I like hiking and being outside, and doing yoga. I am also learning to quilt. My grandmother was actually a seamstress, so she showed me how to sew around the same time I started to walk. I think if you can do something with your hands, it feels relaxing.

I also love to knit and cook. One of the problems with the pandemic is I couldn't have anybody over for a long time, but I love serving good food and wine to friends. It's hard to beat!

What's your favourite kind of food to make?

If you ask my colleagues, they will say that I always make French food when they come over. I like to make simple food with good ingredients. The less you mess with things, the better. I really like making braises. You take a pork shoulder and you cook it in a lot of wine for a long period of time. There is no way it's not going to taste good, right?



Quick facts

Favourite colour? Right now I would say green, but that changes so often.

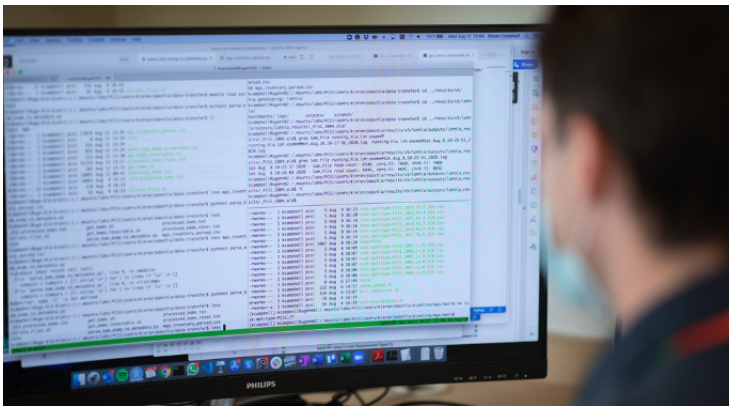
Cats or dogs? Cat. We have one.

What are you watching and reading? Right now I'm just reading scientific papers. I haven't been watching anything of interest, although I had to watch a few tutorials for the quilting because I had no idea.

Coffee or tea? Coffee in the morning, tea in the afternoon and herbal tea at night.

Putting theory into practice

How one LTRI scientist decided to make a difference



From theoretical physics to artificial intelligence for medicine

Last year, Dr. Kieran Campbell helped lead a team of LTRI scientists to develop a groundbreaking new artificial intelligence tool called Astir. This remarkable technology could one day help doctors make faster diagnoses and treatment decisions – all by using artificial intelligence to sort millions of cell types in the human body within minutes.

If you had told him this would happen, earlier in his career Dr. Campbell might not have believed you.

"I started off actually studying theoretical physics – not even close to biology," he says. "I found it somewhat frustrating. It's fascinating knowledge, but it's not going to impact anyone's day-to-day life. That's how I ended up developing computational methods for biomedicine and biomedical applications with a focus on cancers and single cells."

Teaching a machine to differentiate and quantify cells

That pivot is already producing major results. Astir is a machine learning method outlined in a paper co-written by Dr. Campbell and published last year.

Dr. Kieran Campbell

Astir makes differentiating cell types both more accurate and much faster, which is critical when applied to diseases like cancer.

"When a person develops cancer, there are several different cell types that comprise the tumour itself, and the presence and quantity of each can tell us a lot about potential outcomes," Dr. Campbell explains. "Being able to automatically quantify those cells with Astir takes the guess work out of this critical process, and can help us predict patient outcomes and how well patients will respond to a given therapy."

A team effort

Dr. Campbell credits his colleagues at LTRI for much of his success and inspiration. "I've made some very close connections and close collaborations with different colleagues. There is a whole range of people here at the institute from very focused, fundamental scientists to clinicians that I have met and work with, and that's been very rewarding as well."

An avid traveler, Dr. Campbell is looking forward to getting back on the road once the pandemic is more under control. He's also working on rekindling a childhood passion: playing the piano.

Donor support for LTRI helps fund core research operations, enabling the next breakthroughs in medical science. Thank you for helping people like Dr. Campbell harness the power of artificial intelligence and machine learning to treat complex diseases like cancer.

Astir: what's next?

In the future, Dr. Campbell hopes to apply Astir to other conditions where cell quantification could be important.

He is currently collaborating with Dr. Stephen Lye to explore Astir as a tool to develop treatments for preterm birth, a serious complication of pregnancy that is life-threatening for the newborn baby.

Since a hallmark of preterm birth is an influx of immune cells into the myometrium, Astir could allow doctors to measure the cell types present in patients pre-labour – which could be a valuable tool for developing future therapies.

Thank you

Supporting research is an act of caring. It says that you believe in the power of imagination to effect change, and that you believe in supporting the health of future generations.

At LTRI, we are committed to pushing the envelope of what is possible in medical science. Your support is critical to the day-to-day operations of our work, without which we would be years behind where we are now. We could not be more grateful for your generosity, your leadership and your friendship. On behalf of every person who stands to benefit from the next breakthrough in fighting human diseases: thank you.

See what care can do.

For more information, please contact:

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