

How Canada reversed the 'brain drain'

In the 1990s, we feared a “brain drain” to the United States. But star recruits in science and engineering, such as UBC physicist Jenny Hoffman, have changed the equation.



Jenny Hoffman, a professor of quantum materials at the University of British Columbia, stands on the rooftop of the building where she teaches in Vancouver. Hoffman was lured away from Harvard, in part by the talent north of the border. (Jeff Vinnick for the Toronto Star)

Jenny
calls a

By **KATE ALLEN** Science and Technology reporter
Sun., Nov. 22, 2015

The University of British Columbia is building Jenny Hoffman a hovering nest of concrete: a slab floating on air inside a room inside a room, the better to dampen vibrations far smaller than the twitch of a hummingbird's wing.

They are building Hoffman this laboratory because she is the university's — and almost certainly the country's — newest, shiniest academic hire. The professor of quantum materials was lured away from Harvard to build strange substances that exploit the laws of physics in new ways.

But the lab isn't what drew Hoffman, 37, to Canada. She had pretty great facilities in the U.S. “The main thing is the really terrific community here,” Hoffman says. “UBC has definitely the strongest quantum materials group in North America, possibly in the world. And they're really nice, collaborative, friendly people.”

In the 1990s, this country was consumed with the spectre of a “brain drain”: the loss of scientific, engineering and medical talent to the U.S. in an era of Canadian belt-tightening.

“There was a very real concern that the scientific community in the country would implode,” says Alan Bernstein, president of the Canadian Institute

for Advanced Research (CIFAR). “Science is all about people. So when you invest in science, you’re investing in people. And when those people leave, you have nothing.”

A slew of programs, old and new, have reversed the brain-drain narrative. Hoffman may be the poster child for their combined effects, and their success at cultivating deep reservoirs of talent.

The field of quantum materials is devoted to inventing and exploring substances that behave in novel ways under extreme conditions. Researchers are exploring materials, for example, known as “superconductors”: below a certain temperature they lose all electrical resistance, meaning they can sustain a current indefinitely. A material that superconducts at ambient temperatures would revolutionize many technologies — think lightning-fast smart grids and magnetic-levitating trains — and a moon-shot goal of Hoffman’s and many others is to find a room-temperature superconductor.

“We’ve gotten to the point now where we understand the laws of quantum mechanics somewhat better, and we can make predictions,” Hoffman says. “We can say, hey, even though we can’t go into a mine and dig this up, we would really like a material that does “X”: that conducts electricity without loss, that is harder or more flexible or springier than any material that we have today. Instead of hoping that someday someone is going to discover it underground, we can make it.”

While the applications are dazzling, much of the research is pure, exploratory basic science — an enterprise that requires time and money. At Harvard, Hoffman built specialized microscopes to examine the properties of newly created quantum materials. But her interests began to drift, and she grew more interested in creating the materials than looking at them. She won some grants to do that, but felt isolated. She drafted a list of schools she might want to work at, and UBC was the only Canadian school on it.

With three kids under 10 and an impressive ultrarunning career on the side — Hoffman won the U.S. 24-hour national championship in 2014 and again this year, logging more than five consecutive marathons in a day — she hardly had time to aggressively scour the job market. Luckily, a series of meetings drew her to Vancouver.

One, in October 2013, was hosted by CIFAR. By creating broad research programs and inviting the best scientific minds in the world to collaborate, its goal since its creation in 1982 has been to give top researchers an intellectual home base, keeping the best in Canada and attracting new talent too. She was impressed by the community. At CIFAR meetings, “it feels like people are going because they really want to discuss the problems they’re working on.” She has since become a member of CIFAR’s quantum materials program.

Back for another set of talks the next month, Hoffman persuaded Douglas Bonn, the head of UBC’s physics department, to join her on an early-morning run in Stanley Park. She asked if they were hiring and Bonn told her they were looking to fill a Canadian Excellence Research Chair (CERC).

In the year 2000, the Canada Research Chair program created 2,000 funded positions with the explicit purpose of attracting and retaining the world’s top minds. The CERC program is an outgrowth of that, providing a bigger pot of money to an even smaller and more selective pool: 24 researchers each receive up to \$10 million over seven years.

Hoffman was offered the CERC job. As icing on the cake, the federal government announced in July that UBC’s Quantum Matter Institute was one of five inaugural winners of the Canada First Excellence Research Fund, a \$1.5-billion pot of research dollars to be doled out over seven years. “You need money to attract top people, because they can’t do their work unless they have enough money to buy the equipment they need to do it,” Hoffman says. The CERC was attractive and the Canada a bonus, allowing the whole group to “focus on pushing the science forward faster.”

Bernstein and others say Canada’s research-excellence ecosystem is better than it ever has been at retaining and attracting top talent. But there are still holes: even as mature researchers stay, academics voice concerns about losing young people to the U.S., especially to Silicon Valley, currently awash in venture capital. Canada will always be a small country in a big world.

Brain drain “is going to continue to be a threat,” says Bernstein. “We’re always churning out really smart young people, and we need to make sure they have opportunities here in Canada.”

Canada’s great gets

These star researchers could have gone anywhere in the world, but chose to work in Canada.

Graham Pearson



Graham Pearson. (Richard Seimens)

Where they came from: Durham University in U.K.; previously a Carnegie Fellow in U.S.

Currently teaching at: University of Alberta (Edmonton)

The Canada Excellence Research Chair in Arctic Resources studies diamond formation and the deep roots of continents. He is working to create a detailed picture of the diamond resources in the Arctic and develop new technologies for diamond exploration. He also created novel geochemical tools aimed at developing a fingerprinting technology that can determine the geographic origin of minerals — of impact in the issue of “conflict diamonds.”

Steven Bryant



Steven Bryant.

Where they came from: Bank of America Centennial Professor at University of Texas at Austin.

Currently teaching at: University of Calgary

Bryant, a nanotechnology researcher, was hired away from Texas as another Canada Excellence Research Chair. His work at the University of Calgary combines nanotechnology, materials science, chemical engineering and geoscience to make oil recovery more efficient and less environmentally damaging.

Howard Wheeler



Howard Wheeler. (David Stobbe)

Where they came from: Cambridge-educated Wheeler was professor of hydrology and director of the Environment Forum at Imperial College London.

Currently teaching at: University of Saskatchewan (Saskatoon)

Yet another Canada Excellence Research Chair, Wheeler is an international expert in sustainable water management. He leads the University of Saskatchewan's Global Institute for Water Security, working with a multidisciplinary team on issues like climate change and socio-hydrology, to develop tools to assess environmental risk, and develop better water policies.

Samar Safi-Harb



Samar Safi-Harb. (Marny Barnes)

Where they came from: Studied at American University of Beirut and University of Wisconsin-Madison; held NASA post-doctoral fellowship before coming to University of Manitoba as NSERC University Faculty Award Fellow

Currently teaching at: University of Manitoba (Winnipeg)

The astrophysicist studies the remnants of supernovas to help understand some of the mysteries of the universe, such as the acceleration of cosmic rays to extraordinary energies and the formation of the most magnetized and exotic compact stars. She is a Canada Research Chair in supernova remnants astrophysics.

Stan Metchev



Stan Metchev.

Where they came from: Hired away from SUNY Stony Brook; degrees from Harvard and Caltech

Currently teaching at: Western University (London, Ont.)

What: Metchev holds a Canada Research Chair in extrasolar planets; he studies the atmospheres of exoplanets (planets around stars other than our own), and leads the “Weather on Other Worlds” program that uses NASA’s Spitzer Space Telescope to discover storms on distant brown dwarves.

David Cory



David Cory.

Where they came from: Professor of nuclear engineering at Massachusetts Institute of Technology before moving to Waterloo

Currently teaching at: University of Waterloo

Cory moved here to accept the Canada Excellence Research Chair in quantum information. He works on tools that will form the underpinning of quantum computers, a type of machine that, if created, would be revolutionary because they work so much faster than classical computers.

Mark Fenske



Mark Fenske

Where they came from: Jointly appointed at Harvard Medical School and Massachusetts General Hospital before coming to Guelph.

Currently teaching at: University of Guelph

Fenske, a neuroscientist and psychology professor, uses neuroimaging techniques and behavioural experiments to study factors that are crucial for healthy cognitive and emotional functioning; some of his research has focused on how attention, emotion and previous experiences affect recognition of faces and objects. He co-authored the bestselling "The Winner's Brain: 8 Strategies Great Minds Use to Achieve Success."

Jianhong Wu



Jianhong Wu.

Where they came from: To quote a previous Star story, “Wu Jianhong was born a genius, admitted to China’s Hunan University at age 15 and earned his doctoral degree in dynamical systems and math eight years later.”

Currently teaching at: York University

The title of Wu’s Canada Research Chair position — industrial and applied mathematics — sounds a lot drier than it should, since Wu uses math to model the spread of infectious diseases, among other applications. Recent research, for example, suggested media coverage can affect when a disease outbreak peaks.

Candice Monson



Candice Monson.

Where they came from: Professor of psychiatry at Boston University School of Medicine and deputy director of Women's Health Sciences Division of National Center for PTSD at Boston VA Healthcare System.

Currently teaching at: Ryerson University

Monson's IMPACT lab focuses on why individuals respond to trauma recovery differently and what therapies could be more effective in treating disorders like PTSD. She is director of clinical training at the lab, teaching students to become successful psychologists.

Yu-Ling Cheng



Yu-Ling Cheng. (HENRY FEATHER)

Where they came from: Born in Taiwan; degrees from MIT, Stanford.

Currently teaching at: University of Toronto

Cheng has received grants from the Bill and Melinda Gates Foundation and Grand Challenges Canada to pursue her research goals: developing safe, affordable sanitation technologies for the developing world. She directs U of T's Centre for Global Engineering, a multi-disciplinary hub that promotes creative thinking about global problems.

Salim Yusuf



Salim Yusuf.

Where they came from: Native of India, Rhodes Scholar, and doctor with a degree from Oxford; Yusuf worked at U.S. National Institutes of Health before coming to Ontario.

Currently teaching at: McMaster University (Hamilton)

Yusuf, a cardiologist and epidemiologist, was inducted into the Canadian Medical Hall of Fame last year for his internationally-recognized leadership in the study of population health, particularly cardiovascular disease: his research has spanned 83 countries.

Shana Poplack



Shana Poplack.

Where they came from: U.S.-born Poplack earned degrees from New York University and University of Pennsylvania before moving to Ottawa in 1981

Currently teaching at: University of Ottawa

Poplack has won a panoply of prizes for her research on sociolinguistics. The Canada Research Chair studies natural speech in its social context, and is a world expert on bilingualism: her research has particularly focused on the dynamics of Canadian French and the interaction of Canada's two official languages.

Vicky Kaspi



Vicky Kaspi. (Owen Egan)

Where they came from: Kaspi got her PhD at Princeton under supervision of a Nobel Prize-winning astrophysicist, then worked at NASA's Jet Propulsion Laboratory and Caltech before being appointed professor at MIT. Came to McGill two years later.

Currently teaching at: McGill University (Montreal)

Kaspi, another scientist with a clutch of awards in her name including the Herzberg Medal and the Steacie Prize, studies neutron stars and pulsars. She was awarded one of the first Canada Research Chairs to study these exotic cosmic objects, which help reveal facts about the fundamental physics of the universe.

Doug Wallace



Doug Wallace.

Where they came from: Originally from U.K.; spent most of career in U.S. and Germany.

Currently teaching at: Dalhousie University (Halifax)

Wallace, the Canada Excellence Research Chair in Ocean Science and Technology, studies the changing chemistry of the world's oceans — particularly acidification and the carbon cycle, both significantly affected by climate change.

Clearing the brain drain

The “brain drain” of Canada’s research and medical elite attracted rampant speculation in the 1990s, with pundits blaming everything from high taxes to shoddy facilities. But did the brain drain actually exist?

In 2000, Statistics Canada analysts published research examining the migration of knowledge workers in the preceding decade in an attempt to answer that question. The result was a lot more complicated than the blaring headlines.

Who left?

25% Of the supply of newly graduated doctors, a full quarter left for the U.S. in 1996-97, about 450 in total. Canada lost 4% of its university graduates in engineering in 1995 and 1% of its natural scientists.

49% The leavers were desirable, highly educated workers: nearly half of the adult Canadians who migrated to the U.S. between 1994 and 1999 had a university degree, compared to 12% of the general Canadian-born population. They were also richer than most: 1996 Canada-to-U.S. émigrés were seven times more likely to report incomes of more than \$150,000.

2:1 The knowledge exchange was uneven, with double the number of post-secondary faculty who moved from Canada to the U.S. compared to the other direction. According to data from what is now called Universities Canada, senior professors were more likely to leave the country than move between provinces.

Who came?

15x However, between the mid-1980s and 1997, the immigration to Canada of computer scientists — a particularly coveted skill set — increased 15-fold; engineers increased 10-fold and natural scientists increased eightfold.

2x According to the 1996 census, recent immigrants to Canada were twice as likely as the Canadian-born population to be working as computer scientists, engineers or natural scientists. They were also twice as likely to have a university education, and even more likely to hold an advanced degree (a master's degree or doctorate).

4:1 The number of university graduates who entered Canada in the 1990s outnumbered those who left for the U.S. by a ratio of about four to one; 39,000 degree-holders entered Canada per year between 1990 and 1996, while an estimated 10,000 left for the U.S. per year. So while a disproportionate number of highly desirable workers left Canada for the U.S. in that decade, Canada enjoyed a net gain in skilled labour.

What about now?

35% The annual number of individuals who left Canada to live in the U.S. dropped from 113,100 in 2000 to 73,000 in 2006. The number had been rising steadily between 1986 and 2000.

1.7 In 2001, for every one individual leaving the U.S. for Canada, there were 2.2 moving the opposite way; by 2006, that number dropped to 1.7.

10% Health professionals are still overrepresented in the Canadian diaspora living stateside, representing 10% of Canadians there versus 5% here. Among the diaspora in the U.S., the percentage of Canadians in professional, scientific and technical services careers also rose slightly from 12% in the '90s to 14% between 2000 and 2006.

21% About one-fifth of all 2005 doctoral graduates intended to leave Canada after completing their degree and more than half of those planned to move to the U.S. Yet more than eight out of 10 said they intended to return. Two years after graduation, a quarter of those who had left for the U.S. had returned, and the majority still said they planned to do so.