UNDER THE MICROSCOPE

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TORONTO -- Lead

The postdoctoral fellow thought he was losing his mind. Or, more unthinkably, that he was a bad chemist.

For some reason, data generated by a graduate student, his colleague at a prestigious laboratory at the University of Toronto's Mississauga campus, was not adding up.

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And so, in the late afternoon of Feb. 4, 2015, he let himself into a room at the lab to gather test materials and get to the bottom of what was wrong. There, on the upper shelf of a storage fridge, he came upon a box of chemical compounds that had ostensibly been tested by his colleague.

The postdoc was a senior member in the lab, which is helmed by Patrick Gunning, a rising star in the world of medicinal chemistry and oncology, whose work has attracted tens of millions of dollars in donations, government funding and venturecapital investment to the university.

His Gunning Group lab is among a handful around the world racing to unlock the secret behind STAT inhibitors - molecules that, in theory, are able to turn off a switch inside cancer cells, killing those cells while leaving healthy ones unharmed. Such research, it is hoped, will lay the groundwork for a revolutionary treatment of some of the most aggressive and deadly cancers.

What the postdoc found that winter day would lead him to raise uncomfortable questions about aspects of that research as it was being conducted in the Gunning lab.

His colleague, he discovered, had fabricated data. That discovery, along with additional questions about some of the grad student's research, in turn cast doubt on the lab's claims about the performance of one of its molecules, according to the postdoc and two former Gunning Group members with direct knowledge of the events.

The postdoctoral fellow brought his concerns to Prof.

Gunning almost immediately, in early 2015. About one year later, Claudiu Gradinaru, chair of the department of chemical and physical sciences at UTM, asked the postdoc for a full account of the data-fabrication aftermath, as part of a review into Prof. Gunning's promotion to full professor. That was the last time the postdoc heard from Prof. Gradinaru, or anyone from the faculty, about the matter.

To piece together what happened inside Prof. Gunning's lab, The Globe and Mail obtained university records; reviewed several scholarly articles and their supporting information with the help of scientists; interviewed 22 experts in research ethics, drug discovery and oncology; and spoke with more than a dozen former Gunning Group researchers. The Globe granted the lab members confidentiality because they feared professional reprisal in research circles, where career trajectories are carved with the help of reference letters from supervisors past and present.

The Globe investigation, conducted over the course of a year, reveals that the fabricated data remain in circulation today and have been cited dozens of times by the scientific community in various papers and publications.

Values identical to the fictional ones were also used as evidence in a patent for one of the lab's most promising compounds.

The postdoctoral fellow who exposed the fabrication now works on drug-discovery projects at a Toronto hospital. He agreed to speak to The Globe, ultimately participating in nine interviews, because he is frustrated by how the university addressed the situation. He believes the public and the medical community have been misled about the promise of one of the lab's star contenders in the fight against cancer.

His discovery in the fridge that day was the beginning of understanding, he says, "that I wasn't insane, that I wasn't doing something wrong and everybody else was doing it right. I saw that there was a very big systematic problem in the lab."

Prof. Gunning acknowledges that the data fabrication occurred, but maintains that the graduate student's misconduct, "in the end had no impact on the direction of any" of the Gunning Group's research-and-development programs. He disputes, as well, that the fabricated data appear in published works and a patent application for cancer-targeting compounds developed in the lab.

"There is no fabricated data in circulation - period," Prof. Gunning said in a January, 2019, statement to The Globe, sent through his lawyer.

In response to questions from The Globe, Prof. Gunning said he has evidence to back up his assertions, but he declined to disclose it unless the newspaper involved a "legitimate mutually agreed upon independent expert to review your 'story.' " Owing to confidentiality issues surrounding his research program, he said, he also wanted The Globe to sign "an appropriate" non-disclosure agreement. The Globe did not agree to these terms.

In 2016, at the time the allegations were submitted to the department chair, U of T's office responsible for research integrity was not called to investigate.

This past June, however - more than six months after The Globe first sought comment from university officials - the University of Toronto said it had recently concluded a preliminary inquiry into the matter and found no grounds to proceed. "The allegations of research misconduct were determined to be entirely unjustified and no further investigation was recommended," Vivek Goel, vicepresident of research and innovation, said in a statement. "The University accepted this recommendation and now considers the matter closed."

Chemotherapy, the most common drug treatment for cancer, lays waste to all kinds of healthy cells. Thus its harrowing side effects: a severely weakened immune system, organ damage and even the risk of triggering a second cancer.

Such consequences have spurred the search for what are known as STAT inhibitors. The acronym STAT stands for "signal transducers and activators of transcription," a family of seven proteins that perform important cell-housekeeping functions in the human body.

When abnormally activated, STATs can also push a cell into overdrive, leading to outcomes associated with cancer, such as tumour growth and resistance to treatment.

STAT inhibitors work to block specific signalling pathways that allow unwanted communication between cells. Unlike the drugs used in chemotherapy, which affect many pathways indiscriminately, such compounds are designed to target and inhibit only the pathways that promote cancer growth. "Selectivity - the ability to just hit your target, and on a broader scale, the ability just to kill the cancer cell and not harm normal cells - is the difference between a really effective anti-cancer drug and just some new toxic agent," says Dr. David Frank, a medical oncologist and associate professor at Harvard University.

The first real breakthrough for a selective cancer drug took the form of a pill called imatinib mesylate, commercially known as Gleevec, approved by Health Canada in September, 2001. Gleevec was embraced as a "miracle drug" by patients suffering from chronic myelogenous leukemia (CML), which causes drastic overproduction of immature, or "blast," white blood cells that crowd out normal blood cells. Because Gleevec is able to precisely target three of the 500 human-genome kinases (a type of enzyme that can turn certain proteins on or off), taking one pill a day has transformed a lethal cancer into a treatable chronic illness.

With pervasive activity of STATs across a number of tumour types, says Dr. Antonio Iavarone, a Columbia University professor of pathology, cell biology and neurology, such proteins are "a crucial target for which the goal of identifying compounds - molecules that can interfere with this activity - is a very important goal in cancer medicine."

The Gunning Group lab is home to a variety of drug-discovery research projects, and last year was a recipient of the university's prestigious Connaught Innovation Award for developing a rapid diagnostic test to detect bacterial infections in blood and in cerebrospinal (brain and spinal cord) fluid. Its flagship STAT-inhibitor project has brought significant funding dollars to the university, which, in promotional material, lauded the lab's potential to "revolutionize cancer treatment as we know it today."

Prof. Gunning himself is a bona fide academic celebrity and, by many accounts, is an excellent scientist. Born in Scotland, and with a PhD from the University of Glasgow, he worked as a postdoctoral research associate at Yale University before arriving at University of Toronto Mississauga in 2007. By 2015, his resume listed close to 20 research honours and $13-million in grants and prizes for his work in chemistry. The median age to be appointed full professor in Canada is 46; Prof.

Gunning was promoted to the post at age 37.

Prof. Gunning declined several requests to be interviewed for this article, but answered some written questions. "I have dedicated my career to cancer research and training the next generation of hard-working and passionate innovators who can bring life-saving therapeutics to patients," he said in a December, 2018, statement to The Globe.

At the U of T, he is one of roughly 250 Canada Research Chairs - a federal designation meant to recognize "some of the world's most accomplished and promising minds." His related funding was renewed in 2018 at $100,000 a year for the next five years.

So vital is Prof. Gunning's work to the campus that the university has called it the "catalyst" behind its Centre for Medicinal Chemistry, which is expanding to an entirely new building in a couple of years. Construction plans were kicked off, thanks to a $7-million donation Prof. Gunning secured through the Orlando Corporation, Canada's largest privately owned industrial real-estate developer, as well as another almost $6-million in public grants.

What Prof. Gunning has described as "a $150-million building" is the second-most expensive ever to be built at the U of T, a university spokesperson confirmed. (The most expensive building will be a downtown innovation centre, announced in March, and made possible by a $100-million donation by Gerald Schwartz and Heather Reisman.)

The Gunning Group has close to 30 graduate-level members today - about two-thirds of whom are doctoral students or postdoctoral fellows - sharing a state-of-the-art laboratory that saw major renovations and upgrades about three years ago.

In 2013, the lab was a more modest operation, albeit one with ambitious goals. That year, Prof. Gunning won an Inventor of the Year award at the U of T, according to a university brochure, for his work in pioneering "the most potent small-molecule 'drug-like' inhibitors" for a compound called BP-1-102.

By 2015, the lab had moved on to what it claimed was an even better compound: AC-3-19.

One afternoon in February of that year, the postdoctoral fellow entered a room in the lab to gather chemical compounds for a scientific control experiment that he hoped would help make sense of data from tests conducted by his graduate-student colleague, Aleksandra Todic.

Ms. Todic was responsible for running a continuing experiment called fluorescence polarization, which tests the ability of compounds that were designed by her colleagues to bind to STATs in a controlled environment - like a key in a lock.

She would repeat such an experiment whenever a new compound needed screening, or had to be tested under different conditions. Inhibitors that showed promise would advance to the next tier of experiments, including in human cells (examined in Petri dishes) and in mice.

But the postdoc fellow was confounded by Ms. Todic's data, which did not match the discouraging results he and his colleagues were observing in different experiments - namely, that the compounds were binding erratically to many targets.

Thus did he find himself sliding open the lab fridge door, zeroing in on a plastic box tucked away at the back of an upper shelf.

It contained 26 short scintillation vials, a kind of test tube in which lab samples are stored.

The compound names written on the vials were familiar to him: Ms. Todic had already reported the data, which meant she should have dissolved those compounds.

So why were they still in the fridge?

Concerned that Ms. Todic's experiments were perhaps done incorrectly, or worse, not at all, the postdoc soon shared his discovery with another research fellow.

They sought clarity from Ms. Todic, but got none. And after doing some additional sleuthing, they chose to sound the alarm.

Six days after the discovery in the fridge, the two postdoc fellows brought their concerns to Prof. Gunning, so that he could request the raw data from Ms. Todic.

She sent the professor graphs drawn on a graph pad; in other words, still not the raw data.

There were simply no signs of it having been generated from lab work.

The two men also called on a third postdoc in the lab to help weigh the minute amounts of compound in the vials from the fridge, in order to gauge if any material had been removed for possible testing. Of the samples they could weigh accurately, no compound had ever been taken out of the vials.

There seemed to be only one explanation: Ms. Todic's data were simply made up.

The implications were alarming. Dozens of compounds - the lab had designed about 150 by then - may have been screened by a student who had fabricated data. This, in turn, meant that, for the key compounds that had made it through the drug-discovery pipeline to later experiments, favourable results could not definitively be attributed to the lab's hypothesis that the compound was

binding selectively to the STATs.

After all, destroying cancer cells is the easier part; it's the fact that these compounds were claimed to keep healthy cells alive that made them special, a claim built in part on a foundational experiment that now had some cracks.

The most important of those compounds was the lab's star molecule at the time, AC-3-19, on which Prof. Gunning had applied for a patent. (It is still touted as a star in the lab today, according to a March, 2019, public presentation by Elvin De Araujo, a senior researcher in the lab.)

The two postdocs brought the evidence forward in a meeting with Prof. Gunning and Ms. Todic on Feb. 12, 2015. There, she admitted to fabricating data.

The timing was fateful.

A journal called ChemMedChem was near the point of publishing a manuscript - that had passed peer review, and was being proofread - co-authored by Ms. Todic and another Gunning-lab PhD candidate, Abbarna Cumaraswamy, who declined to be interviewed for this story. The day after Ms. Todic's admission, Prof.

Gunning e-mailed the journal's then-editor, Natalia Ortuzar, according to e-mails obtained by The Globe.

(The e-mails were part of 215 pages of records located by the university's Freedom of Information and Protection of Privacy Office in response to The Globe's request for records related to the data fabrication. The office released only five of those pages; the others, it said, were protected by exemptions involving labour relations, research confidentiality and personal information.)

"I cannot in all consciousness and at risk to my reputation and that of my group have it published without having all the experiments rerun," Prof. Gunning wrote to Dr. Ortuzar, adding that the offending lab work "constitutes one graph in the manuscript."

In another e-mail to her later that day, he emphasized wanting to take "no chances on anything right now that [Ms. Todic] touched which is thankfully, very little."

The postdoctoral fellow who had discovered the vials told The Globe he had been enlisted to rerun the experiments after Ms. Todic's departure from the lab.

A revised paper was never submitted to ChemMedChem.

Prof. Gunning said, in a statement to The Globe, that this was because "by the time we had a chance to verify the data, another lab working in our field of research published a paper that removed the novelty of findings in our manuscript."

Despite the competitor lab's publication, however, Dr. Ortuzar had replied in a June, 2015, e-mail that the journal "would be happy to reconsider the revised version currently in preparation."

The postdoc has a different explanation than that offered by Prof. Gunning for why the manuscript never made it into the journal's pages. When the postdoc had rerun the fabricated experiments, his data showed results that were far less impressive. The falsified data suggested the molecule was 2,200 times more effective than it was, in reality.

What's more, the postdoctoral fellow's investigation concluded that AC-3-19 demonstrated no selectivity when it came to discriminating between the STAT variants investigated in that manuscript. It was also less effective at binding to STAT proteins when compared with naturally occurring compounds that were used as controls in the experiments (in this case, growth-hormone fragments).

The postdoc has an extensive background in organic chemistry.

Before joining the Gunning Group, he completed a PhD and two postdoctoral fellowships - one at the University of Oxford and the other at UTM - achievements that later landed him a senior role in drug-development research at a prominent Toronto hospital, where he continues to work.

Still, he wanted to enlist a colleague, this time a graduate student, to do a blind that verified the unsettling results of his investigation. The graduate student detailed his observations in several interviews with The Globe.

Those various findings propelled the postdoc to revisit yet another article, which had been submitted by the Gunning Group to Medicinal Chemistry Letters, a journal of the American Chemical Society, almost a year earlier, in April, 2014.

That article posits AC-3-19 as the most selective inhibitor known at the time, an assertion supported in part by Ms. Todic's data - but not by the postdoc's retests. He also discovered that Ms. Todic's results had been expressed in nanomolar units. His own experiments, however, delivered results that were in micromolar units. In other words, Ms. Todic's final numbers were off by a factor of 1,000.

A month after submitting that article to Medicinal Chemistry Letters, the Gunning Group had filed a provisional patent on the compound, whose apparent success would be unveiled to the scientific community a few months later, when the article was

published in September, 2014.

Ms. Todic's name appears fourth on the article's 13-person author list, right after the names of three senior researchers who contributed equally to the work.

(In the scientific world, authorship is typically ranked in order of research contribution, with the supervisor's name usually appearing last.)

The first three authors listed on the article are also named as coinventors, alongside Prof. Gunning, on the AC-3-19 patent application. The Globe reviewed the patent documents, which include a table containing data identical to the fabricated test results that bolstered the claim of selectivity.

Universities routinely patent their intellectual property. Securing a patent for a new invention can help attract private investment, said Timothy Caulfield, a professor at the University of Alberta and a Canada Research Chair in health law and policy.

"They're still viewed, rightly or not, as a valuable part of the innovation process," he says. "There has been intense pressure on researchers to not only translate their work, but commercialize their work."

Dr. Leighton Grimes, an immunobiology researcher at Cincinnati Children's Hospital, collaborated with the Gunning Group on the 2014 article. After it was published, his lab, which specializes in leukemia research, did not continue investigating the compound.

"One of the reasons we discontinued it was that the compound was creating havoc in the cells that was not specific," he said in a July, 2018, interview with The Globe.

"That thing is never going to make it into the clinic as far as I'm concerned," he said of the compound, which unfavourably targeted mitochondria, the cell's energy generators, in the experiments.

Dr. Grimes added that he wasn't aware of the allegations about data fabrication in their joint article. He did, however, subsequently confirm to The Globe that, according to policy, he had notified his own U.S. funders of the allegations.

In May, 2015, the postdoc fellow, having finished his own experiments on AC-3-19, told Prof.

Gunning about problems with the data of Ms. Todic's that had appeared in the 2014 article. He urged that the record be corrected. Prof. Gunning assured him that he would address the issue in a coming manuscript, the postdoc alleges.

But Prof. Gunning never did so.

The professor subsequently told The Globe, in a statement, that a correction was not necessary because the Medical Chemistry Letters article did not contain any fabricated data.

And he maintained that though some of Ms. Todic's data were fabricated, such data were ultimately able to be "reproduced independently" by a different lab member: Dr. Cumaraswamy, who was then a doctoral candidate under his supervision. Dr. Cumaraswamy, who declined to be interviewed, told The Globe in an email there was no fabricated data published and described the underlying science as "credible and beautiful."

The postdoc disagrees with this account. He said he was assigned to redo the tests. And though he shared his results Dr.

Cumaraswamy, neither he nor a junior colleague could reproduce the favourable data.

No corrections, or errata, as they're called in academic publishing, have been added to the article. The article itself has subsequently been cited in other publications.

The data-fabrication incident and its outcome on continuing STAT-inhibitor research in the laboratory was never revealed to Ms. Todic's colleagues by Prof.

Gunning or in team meetings, according to five former Gunning Group members who worked in the lab at the time.

Prof. Gunning wrote in the December, 2018, statement to The Globe that the data fabrication "came to me [as] a shock as this overall highly capable and intelligent student, over a period of time performed good scientific research." It was, he also said, his first time dealing with this type of misconduct and that he had notified the university immediately.

According to U of T's Code of Behaviour on Academic Matters, students accused of misconduct can be referred to a disciplinary tribunal that publishes hearing decisions online. Names of students are redacted, but other identifying information stays on the record, such as their initials, the course code and the dates when the offence occurred. In 2017, to choose one example, the tribunal ruled to suspend a student from the university for a full three years - and required that a notation be put on their transcript and remain there for four years - for plagiarizing Wikipedia in an undergraduate history course.

In his statement, Prof. Gunning said that Ms. Todic was given the option to withdraw from the program. Because she did so, her case never made it to the tribunal.

It remains a mystery why Ms. Todic fabricated the data. Former lab members who spoke with The Globe speculated it could have been a misguided response to high expectations. The most egregious ethical lapses, such as fabrication and plagiarism, are believed to be rare in professional labs, but several experts said intense pressure, high stakes and the thrill of pushing the envelope of human understanding can push scientists, even good ones, over the edge.

Although Ms. Todic initially agreed to speak to a Globe reporter, she later stopped responding to messages. When approached by The Globe outside her workplace, she declined to comment on the fabrication incident. She did confirm she had withdrawn from the University of Toronto to pursue a Masters of Business Administration, a degree that she ultimately completed at the DeGroote School of Business at McMaster University in Hamilton.

The months after her departure from the Gunning Group, meanwhile, were punctuated with terse e-mails from Prof.

Gunning to his team, missives in which he announced new mechanisms to monitor his lab, including the instituting of electronic notebooks in which members record their experimental observations.

Prof. Gunning clearly expected that such monitoring would improve not only honesty, but productivity. "I hope for your sake with the new e-lab book introduction Monday, that you are more productive than is currently visibly observable," Prof. Gunning wrote in a June 3, 2015, email to those working in his lab, and obtained by The Globe through a freedom-of-information request.

He also issued a warning: "I will actively discipline, and pursue under performing group members with a goal of removing the weakest members via the channels available to me. Consider this your notice."

The ensuing months saw many Gunning Group members leave the lab. At least one person, a postdoctoral fellow from France, was fired. (With the help of her graduate-student union, she later reached a settlement with the university for being terminated without cause.)

Of those members who transferred to a new program, one was a PhD student who had originally joined the Gunning lab on the advice of his professors at the University of Oxford. He arrived in September, 2015, with great expectations - and no idea of what had happened a few months prior.

Once there, he began to hear rumblings about issues with the STAT project, he told The Globe.

Eventually, he learned of the fabrication through word of mouth.

But soon, he said, he developed his own questions about the rigour and interpretation of certain data after a handful of frustrating experiences.

The Globe has agreed not to identify the student for fear of professional reprisal to him; he completed his PhD in another lab at the U of T after transferring out of Prof. Gunning's in February, 2016. He is one of at least three graduate students who severed ties with Prof. Gunning's lab between September, 2015, and February, 2016.

In total, The Globe interviewed 10 former Gunning Group members in person or over the phone. Some praised their former supervisor, his lab and its work.

One of those, a postdoc who was a member of the lab during the data-fabrication incident, described his two years there positively: "Prof. Gunning, if he makes a wrong claim, sometimes I think he's not the one to be blamed, it has to be the students who did the work." In the lab, he added, Prof. Gunning was a pleasant supervisor, a very knowledgeable researcher and a charismatic speaker when presenting the lab's work to the public.

The Globe also communicated with six others - by e-mail, social media or in person. One of those was a former postdoctoral researcher who said he "never witnessed any falsified data being published." He asked to remain anonymous, however, because he didn't want to be associated with allegations of misconduct.

In his January response to The Globe, Prof. Gunning said the departures were simply "the restoring of a professional work environment free of disruptive trainees."

In the fall of 2015, the department began soliciting feedback letters from students as part of Dr. Gunning's promotion review.

In one letter, obtained by The Globe, a graduate student described raising what she perceived as research-integrity issues with Prof. Gunning, only to have her concerns dismissed.

Her letter added that "many of the students in the lab feel suppressed and are worried to speak out against Prof. Gunning for fear of him coming in the way of them finishing their Masters or PhD degrees."

The feedback letters were sent to the promotion-review committee, led by department chair Claudiu Gradinaru.

As part of the review, Prof.

Gradinaru also e-mailed the postdoctoral fellow who discovered the data fabrication. Prof.

Gradinaru told the postdoc that he was seeking "an account of what exactly happened and in which sequence," in light of some of the student feedback he was getting.

"Recently, some allegations of scientific fraud and data fabrication in the Gunning lab have surfaced," he wrote in a March, 2016, e-mail reviewed by the Globe.

A few days later, he wrote to the man again, this time explicitly acknowledging the difficulty of making such an allegation, even in a setting otherwise dedicated to the scientific principles of facts and impartiality: "Again, I understand that you are in a delicate situation and are worried about possible repercussions for you personally, but I do not want to force your hand to do something you do not want to do or say something that is not true." By that point, it had been just more than a year since the fabrication had been discovered.

The postdoctoral fellow had since completed his program in Prof. Gunning's lab, and perceived Prof. Gradinaru's e-mail as an endorsement to come forward. He consulted with another professor in the chemistry department as well, for advice on how to write the letter. He submitted a six-page letter to Prof.

Gradinaru in April, 2016, detailing both his discovery of the untested compounds one year earlier and his account of Prof. Gunning's response to the incident, in addition to his other observations and concerns about the research. He copied another faculty member on the e-mail chain, which was reviewed by The Globe.

He also wrote that, in the process of replicating experiments to correct fabricated results that had been the basis for the aborted 2015 ChemMedChem article, he had found that data and claims about the star compound AC-3-19 had been published in Medicinal Chemistry Letters in 2014.

"Unfortunately, her results were inconsistent with my findings. I found no selectivity of binding for AC-3-19," he wrote.

The postdoc told The Globe that he had expected representatives from the university to reach out to him to view his data, or to the 16 people the postdoc named in the letter, that might also have knowledge of issues in the lab.

But the postdoc never heard back from Prof. Gradinaru or any other administrative or faculty members. It remains unclear if the fellow's allegations ever left Prof. Gradinaru's desk. He referred The Globe to university administrators.

In November, 2018, The Globe sent Heather Boon, vice-provost of faculty and academic life at the U of T, a list of 16 questions that included the postdoc's allegations. In a brief statement, she said that research-integrity allegations linked to Prof. Gunning's lab had "not been previously shared with the University," and that "issues raised within the promotions process are dealt with following procedures in that process."

In June, 2019, the university said it had conducted a preliminary inquiry into the matter as a result of The Globe's questions. The allegations were deemed unfounded by a senior faculty member with no ties to Prof. Gunning, according to the statement from Prof. Goel, the vice-president of research and innovation.

As a result, the university said it cannot disclose any specific information about the inquiry. That includes what allegations were tested, what material was reviewed, what data was re-evaluated and who was interviewed.

Six Gunning Group researchers interviewed by The Globe said they were not contacted by the university in relation to this incident, including the postdoc who made the discovery and wrote the letter.

Institutions are obliged to address all research-integrity concerns they receive, even if they are submitted directly to a faculty member. An inquiry into complaints deemed to be made in good faith must be completed within two months in order to determine if the matter will proceed to a formal investigation, which is then usually conducted by the institution's research-integrity office.

These steps are outlined in policies issued by the federal Secretariat on Responsible Conduct of Research, which operates at arm's length from the government. Research institutions must send all investigation reports to the secretariat, where an independent panel decides on sanctions and can order anything from letters of warning to permanent funding bans on the individual.

The need to protect hard-won prestige can prompt universities to deflect threats to their reputations. Institutions face a "brutal disincentive" to investigate their own employees, says Dr. Jonathan Moreno, a professor at the University of Pennsylvania and a leading bioethicist.

There is also a lot at stake for those who allege scientific misconduct.

"Your reputation is your currency," says Raymond De Vries, a professor and associate director at the Center for Bioethics and Social Sciences in Medicine at the University of Michigan.

"If you have aspirations to stay in science, calling somebody out for something - whether you're right or wrong - can be harmful to your career and can mean the end of the line for you."

The mechanism of action (pharmacology lingo for the way a drug achieves a therapeutic effect) is a crucial selling point of the Gunning Group STAT inhibitors. Although the postdoc, former students of the professor and others have serious doubts - which they

say are backed up by evidence - about how AC-3-19 performs its claimed therapeutic effect, that does not necessarily mean it is doomed to failure.

It's possible that a compound could work serendipitously, said researchers who spoke to The Globe, including the postdoc fellow.

At this stage, AC-3-19 and other compounds are claimed to have success in a continuing research project with pediatric surgeon Sheila Singh, a health-sciences professor and Canadian Research Chair in Human Cancer Stem Cell Biology at McMaster University. She says Prof. Gunning is a trusted and ethical scientist.

"We love our collaboration with him," Prof. Singh says of her lab's work with Prof. Gunning, adding that the data-fabrication incident "was a hugely eye-opening and challenging and difficult time for him."

Both their labs are working to develop drug candidates to fight medulloblastoma, an aggressive children's brain cancer that currently has limited treatment options. She called AC-3-19 a drug that has "some toxicity," but that is capable of hitting one target in leukemia cells and a different target in brain-cancer cells.

Prof. Singh's lab is working with an oncology-focused drugdiscovery start-up called Janpix Inc., where Prof. Gunning is chief scientific officer. The company inked a $22-million investment with international venture-capital firm Medicxi, announced in October, 2017 - with plans to get a drug candidate - which Prof.

Gunning has referred to as the patented "Compound X," to clinical trials within two years.

"Working with [Prof. Gunning] has been a complete pleasure for me," Prof. Singh says.

"We have completely different training, we barely speak the same language, but it takes this kind of multidisciplinary collaboration to be able to move forward with anything in science."

Meanwhile, the Gunning lab is continuing to test its compounds in leukemia and brain cancers, and claims that the compounds may also hold promise for treating Duchenne muscular dystrophy (DMD), an incurable genetic disorder characterized by fatal muscle degeneration. That promise has spurred one Ontario couple to raise more than $22,000 in 2019 to support Prof.

Gunning's work through an annual 600-kilometre-long bike ride. Their son has the degenerative disease.

For his part, Prof. Gunning said, in the December, 2018, statement, that his lab is preparing a manuscript "which will serve as a formal peer-reviewed update to the scientific community and address the findings" of the 2014 article, where Ms. Todic's fabricated data was alleged to appear.

But the postdoc fears that meaningful decisions - whether by colleagues on other research projects, or investors or donors who find a personal cause in cancer - were made along the way based on data that was not real.

"What was the point of me even sticking my neck out and writing that, and putting that on the record," he asks, "if nothing was done about it?"