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U of T spinoff poised to revolutionize our understanding of disease

DVS Sciences marketing "mass cytometers"

By ***Jenny Hall***, posted *Wednesday, May 25, 2011*

What do you get when you cross a mass spectrometer with flow cytometry?

Though it sounds like a joke that one scientist might tell another, it's a real question posed by a group of researchers led by Scott Tanner of chemistry.

The answer is "mass cytometry," a radical new breakthrough in the detection of events at the cellular level and the basis for DVS Sciences, a U of T spinoff company that celebrated the opening of a new facility in Markham, Ont., May 12.

In the 1990s Tanner led a research group at another company called Sciex, which itself spun out of U of T in the late 1970s. The group worked on atomic mass spectrometry, a method for measuring the atomic composition of matter. "If you want to know how much arsenic is in well water, how much beryllium is in a nuclear fuel rod or how much gold is in a rock, this is the technology you use," said Tanner. "It vaporizes the sample to its atomic state and counts the atoms."

By the end of the millennium, Tanner's team had conceived a hybrid technology that would apply the principles of atomic mass spectrometry to biology but knew that much interim work would be required to move beyond the idea stage. Sciex was not able to provide the necessary focus to the project at that time, so Tanner "spun in" to the University of Toronto in 2005.

"The University of Toronto was looking for new opportunities for multi-faculty, multidisciplinary studies and we were just that, and looking for a home" saif Tanner. With the university as his home, he has been able to apply for grants, engage with post-doctoral fellows and graduate students and collaborate with other research groups, both inside and outside of the university.

He thinks this was a critical incubation period for his company. "This is where most early stage companies fail," he said, referring to the "valley of death" that occurs between an initial product and its commercial adoption.

While at U of T Tanner was thinking his way into a field that would seem, on the surface, to have nothing in common with his intellectual home of atomic mass spectrometry.

Flow cytometry is a field of biology that looks at proteins, called "biomarkers," on single cells. The objective is to find "signatures" of multiple distinctive biomarkers that could indicate a rogue cell that deviates from the norm — for example, a cancer stem cell circulating in a patient's bloodstream.

Right now flow cytometry uses what's called fluorophores, molecules that emit light when stimulated by lasers. When these fluorophores are attached to molecules that are known to seek out certain types of proteins, they can be used to detect the presence of those proteins. Think of diagnostic tests — put crudely, a "light" is attached to a "seeker" molecule that we know will detect the presence of a certain disease. When we see the "light," we know the disease is present — even when we can't see the disease itself.

The problem is that flow cytometry is limited by the properties of the light being used. At any one time we can only search for four different markers because they emit light at overlapping points on the spectrum, meaning that the messages being sent by multiple fluorophores get garbled.

Enter atomic mass spectrometry. This field had previously only been used to analyze the atomic composition of matter — that is, the elements found on the periodic table. Tanner and his team realized these elements could be used as biomarker probes in place of fluorophores.

Tanner and his group have essentially created a hybrid field, dubbed mass cytometry, that applies the analytical advantages of atomic mass spectrometry to biological cell analysis. Because there are so many different metals

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in the periodic table of elements and because in mass spectrometry they don't "overlap" the way fluorophores do, they let us look at cells with a resolution that had been unheard of up until now.

Consider the example of cancer stem cells. These are the genesis cells for cancer. Cancer treatment is insufficient if it does not destroy all the cancer stem cells in a patient's body. Yet they circulate in the blood at a frequency of one in one million cells. They cannot be reliably detected with traditional flow cytometry. Tanner's group, and others, believe that they can be exposed using atomic mass cytometry.

The ultimate goal is to develop a screening test that would detect diseases like cancer before they become a problem.

But cancer is only one example — the group has collaborated widely with U of T researchers and is looking at the mechanisms underlying other diseases as well. They want to know, Tanner said, "what is the genesis of disease? What is the chemistry that converts a healthy cell into a diseased cell?" Mass cytometry is an enabling technology that will allow these questions to be addressed.

In a recent Perspectives article, the prestigious journal *Science* said "the novel technique of mass cytometry opens a new chapter in single-cell biology" and went on to call the technique a "game changer" that is "poised to revolutionize our studies of disorders of the human immune system."

Professor Peter Lewis, associate vice-president (research) and acting assistant vice-president of the Innovations and Partnerships Office, said that DVS's technology is potentially transformative. "I suspect that one day, we will look back with pride on the fact that U of T played a role in the establishment of DVS Sciences and the life-saving innovations that will emerge from its technology. The relationship between U of T and the researchers who went on to form DVS Sciences is an example of the power of partnership to create real innovation."

Having had the time at U of T to develop and test his ideas, Tanner led the creation of DVS Sciences, which incubated in the Department of Chemistry for six years in what is called the "bootstrap" phase, which means, Tanner said, "that you work from sale to sale and try to survive."

Today the company has formally spun out and has 25 employees spread across the U of T research group, the Markham facility, which houses engineering and production, and a soon-to-be-opened California office that will lead sales and marketing.

The May 12 opening was the result of years of work and much investment by the university and other funders including the Ontario Ministry of Research and Innovation, the Ontario Centres of Excellence, the Ontario Genomics Institute, the Ontario Institute of Cancer Research and the Health Technology Exchange.

Tanner credits U of T and its commercialization arm, the Innovations and Partnerships Office, with helping nurture the company.

"The really good thing about working with the University of Toronto was that this was a totally translational project. We came in with the objective of working at the interface between industry and academia, translating knowledge based within the university into practical (and beneficial) application. We did that by working with groups within the university who collaborated with us in building the technology we needed so we could then move into a commercial opportunity. This was a classic example of the role universities can play as the interface between academia and industry."

(academic programs) (Nov 23/10)
- Professor Ira Jacobs, dean, Faculty of Physical Education and Health (Nov 9/10)