Western Faculty Profile: Dr. Burns Cheadle

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No conflicts of interest declared

Dr. Cheadle worked in the oil and gas industry for 23 years before coming back to his alma mater at Western in 2009 as the Chair of Petroleum Geology. His current role at Western has now branched out beyond just Earth Sciences, and a lot of his work is done for the Faculty of Science as the Director of Science Professionalism and Entrepreneurship. "It's a role primarily created because we saw a need to help students develop professional skills prior going out to careers where they practice their science. As a community in Western Science, we all need to work together and strive towards a greater degree of professional competency in everything we do." He has made strides to accomplish this the creation of the Western Entrepreneurship, which is "an ecosystem that we're creating across campus that will allow faculty, staff, and students access to programs and funds in order to create exciting new ventures."

On the research side, Dr. Cheadle is focusing primarily on one specific area of Earth Science: responsible development. "This department has a long history of association with the mining, and oil and gas industries in Canada. These industries extract resources out of the ground to make the materials and energy that make modern life possible." Dr. Cheadle's research focuses on extracting petroleum resources for the benefit of people, but doing it in a responsible fashion to minimize both environmental and social impacts. "I don't think we can describe this as sustainable development. Once you produce the resources out of the ground, they can't be replaced. It can be done, however, in a way that mitigates the impacts of the extraction processes."

In order to accomplish this goal, Dr. Cheadle's research falls into 2 main streams. The first stream studies oil and gas deposits located inside very fine-grained, low permeability rocks. Until almost 20 years ago, these rocks contained rich oil and gas deposits that were thought to be inaccessible. Now, companies have developed a new technology called multistage hydraulic fracturing that pumps water into horizontal wells to create permeability pathways. However, this new technology has consequences. "We have to use good science to inform the policy and regulations we have around the development of hydrofracking. Is there a better way of using the geological

evidence that we have from wells in the ground? Is there a better way to help fine tune the process of locating where to drill a well and how it's stimulated using hydrofracking? The goal is to avoid overkill; to avoid using brute force techniques and instead take a more surgical approach." The end goal is to promote responsible development by helping oil and gas companies minimize their impact by targeting their operations very precisely.

The other stream falls into public concern around the process of hydraulic fracturing. "When wells are hydraulically fractured, in some instances there have been cases of small earthquakes that have been generated. I'm part of a large collaborative research group that is managed here at Western to understand the science of why these earthquakes happen, what are the conditions under which they occur, and how can we control these hazards." Along with two PhD students, Dr. Cheadle is trying to understand this process from a geological perspective. Most of the other people in the collaboration are geophysicists, who use signals to detect rock properties. "In the oil and gas business, the main technique is what's known as a seismic reflection survey. You can think of this as sonar at the subsurface where you are bouncing sound waves down into the ground, and they reflect and refract off of layers of rock to build up an image. We are currently trying to merge these two fields, and we've come a long way in a relatively short period of time."

By using science to inform industry, Dr. Cheadle believes that he is merging the academic and industrial world together. "We now know that out of all the wells that are drilled and fracked in Canada, about a third of a percent end up generating earthquakes in specific areas. From a scientific point of view, we can learn why these areas are different from all the other areas and point us towards understanding the mechanisms behind what's really going on. From the oil and gas industry point of view, they're saying the same thing. Most of the time they can frack wells and it won't be a problem, but you have to be careful in particular areas. Both the regulations and the industry practices should be informed by good science rather than opinion and politics."

Dr. Cheadle began studying geology because of where he grew up. "I was born and raised in Thunder Bay, and so as a child I grew up surrounded by rocks. I completed my undergraduate degree in Lakehead University, and as I was approaching my 4th year I looked at the geology of the area around my summer cottage, and recognized that nobody has worked on these rocks. So why not me?" Dr. Cheadle then came to Western University to study under Professor Grant Young, who specialized in Precambrian rocks. By the time he completed his PhD, Dr. Cheadle was a specialist at looking at sedimentary rocks and naturally went into the petroleum industry.

After working as an oil and gas geologist for over 20 years, he got to the point where he began thinking about responsible development. "I got a sense that there was a different way of approaching the oil and gas business that hadn't been done up to that point. I thought there was a way that you could balance the economic drivers, the financial needs, of a company with things like social and environmental responsibility. I thought all that could be balanced in a way that is compatible with the idea of responsible development." Eventually, he started his own company because he wanted to do things differently by consulting the community that lived there and constructing sound safety plans with environmental controls. "I was a nonconformist in the oil and gas business, and thought there were different ways of doing things that didn't always match the status quo."

Dr. Cheadle seized the opportunity to leave the industry and come back to academia. "In University, you've got faculty members who have a lot of independence. As a professor, I decide what projects I'm going to work on. If I want to do research on induced seismicity, then that's what I'm going to do. I can tailor a course to teach pretty much whatever I think is important for that course. Academia lacks that sense of central control, and that freedom makes it much harder to work in academia than in industry. Typical professors are constantly struggling with trying to balance what to do next, and how to maintain the level of success they've had. The environment which we live in is very ambiguous, in the sense that we're reinventing ourselves all the time. When working in industry, those roles tend to be more clearly defined."

The most rewarding part of being a researcher for Dr. Cheadle is filling his naturally insatiable curiosity for the natural world. "Academia is one of the only places where you can satisfy that curiosity on a daily basis. Just look at the resources that we have at our fingertips: to be able to turn on a web browser and access this huge library of information at basically no cost. It boggles my mind every time I can do that, because this was a big impediment when I was in industry." Overall, the barrier to knowledge is much lower with the advent of an online catalogue with collectively pooled research from all around the world.

Overall, Dr. Cheadle believes that the future of petroleum geology is bright. "A question I often get from students is, isn't oil and gas a sunset industry? Are they making the right choice going in that direction? The reality is that we don't have a simple replacement for petroleum right now. As a species on Planet Earth today, we use give or take, 550 quadrillion BTUs of energy, and of that 85% comes from fossil fuels. It's going to take a long, long time to wean ourselves off of oil and gas and onto other things. It will get more and more difficult to extract oil and gas out of the ground. We've been doing this for over 150 years now, and eventually there will be better alternatives that will

replace oil and gas. I think because of changes in social expectation both in terms of environmental and social impact, the way oil and gas is done will shift dramatically." In the technical aspect, Dr. Cheadle believes that we will have to understand rocks at a much more microscopic level. "Instead of taking a rock sample and putting it under a light microscope, I have to take a rock sample and then use a focused ion beam to polish the surface and then put it on a scanning electron microscope and crank it up to a very high magnification in order to see the pores in those rocks. Now some of the research is looking at how the physics change when working at such small scales."

What are some of the aspects of a potential graduate student for hire? "This will come as no surprise from the Director of Science Professionalism, but I'm looking for a level of professionalism. That's a very vague term, and I give a lot of thought to what this term means. First and foremost, I want people who are striving for autonomy, who want self-management. Any professor will say that if you have a student that can take the ball and run with it, it's much better than have someone who is routinely in your office asking what to do next. This sense of self-determination is very important. Obviously, I need people who have that thirst of knowledge, and are also insatiably curious. They really have that drive to know more, and they need to be able to present some evidence of that. When I talk to prospective graduate students, it's like interviewing a new employee. I tend to choose people who have evidence of a good moral compass, have a sense of ethics, and can work well together in teams. They need to be able to weigh the impact of their actions on others very carefully. Beyond that, I am looking for people who are diligent and can deal with ambiguity. The nature of most graduate research is that the project tends to shift as you work on it. I need people who are able to adapt. The way we go about teaching and conducting research should involve more than simply our ability to manipulate information and create knowledge. I think you have to pay attention to character; you need to pay attention to continuing to develop competence in all those other professional traits in addition to maintaining expertise in your subject area. Unless you can pull all that together, you're not going to be particularly effective. You have to be sufficiently innovative, and think like an entrepreneur."

To learn more on Dr. Cheadle's lab and research, please visit his website at:

<https://www.uwo.ca/earth/people/faculty/cheadle.html>