

# | TSHILIDZI MARWALA |

## TOP THREE AWARDS

- National Order of Mapungubwe (Bronze), 2004
- National Research Foundation President's Award (P-Rating), 2003
- Being elected to The World Academy of Sciences, 2010

## DEFINING MOMENT

"The birth of my three children, and meeting my wife Jabulile."

## WHAT PEOPLE DO NOT KNOW

"I run every morning for 30 minutes."



## FROM BIG CITY TO BIG SCIENCE

In a time when “ozone layer” and “superconductivity” were the buzzwords of modern science, matric pupil Tshilidzi Marwala found himself in London, the biggest city he had ever seen, and a setting worlds apart from his home town of Duthuni, Venda.

“Everyone was talking about eliminating friction so that trains would use very little energy. And we didn’t know what climate change was yet – the big issue discussed by the British Minister of Science and Technology at that time was the ozone layer.”

It was 1989 when he was at Mbilwi Secondary School, and part of a group of elite students from across the world. He was chosen because he was a finalist in the National Science Olympiad.

“My prize,” says Marwala, now a Professor serving as the Deputy Vice-Chancellor of Research, Innovation, Postgraduate Studies and the Library at the University of Johannesburg (UJ), “was a fortnight’s visit to Britain’s capital”.

Reflecting on his life’s journey from the couch of his office, he notes that this overseas trip was preceded by a week-long visit to Johannesburg to attend National Science Week – the “biggest city he had ever visited” for about a week before going to London.

“I didn’t understand the cold war or other big global issues. And I didn’t know what engineering or artificial intelligence was. But it was during this excursion, while staying at the University College London and visiting Oxford University, that I decided to spend the rest of my life in science and technology.”

He returned to South Africa certain of two things: he would study science, and he would study outside South Africa. Unfortunately, on the train back to Venda to write his matric exams, he was robbed.

“When I arrived home I was barefoot, and I did not have a single picture from my trip. They took everything.”

But life went on, and for the rest of his final school year, he wondered how he would be able to go overseas to study.

Then in December the letter came: “You are going to St John’s College in Johannesburg to do your British A-levels”.

Marwala went, completed his A-levels and then set off to the University of Cape Town in 1991 to begin a degree. In March that year he once more received a letter with a study opportunity in Ohio in America.

“I had never heard of that place. I thought it was pronounced “oh-hee-oh”, rather than “oh-high-oh”, he remembers with a chuckle. “They gave me the name and location of the university, but without Google there was no way to get more information other than going to the American embassy to pick up a big book of US universities.”

Four years later, Marwala returned to South Africa with a BSc in mechanical engineering (*magna cum laude*) from Case Western Reserve University. He briefly worked at the Council for Scientific and Industrial Research (CSIR) before getting a call from his mother.

“She said she had received a letter from a Professor Stephan Heyns at the University of Pretoria, requesting that I come and see his lab. So I went, and I decided to do my Masters in mechanical engineering there.”

## MULTIPLE DISCIPLINES

Thereafter, Marwala again left South Africa to complete a PhD in artificial intelligence at the University of Cambridge, London, where it all began back in 1989.

He believes in the value of being multidisciplinary. During his own undergraduate degree in America, Marwala had dipped his feet in the waters

of psychology, history, economics and even acting, despite majoring in engineering. It was this broad, multidisciplinary grounding that eventually led him to what has become the scientific buzzword of our time: artificial intelligence.

"The books I have written are in diverse fields. There is artificial intelligence in everything I do, but it is multidisciplinary." Indeed, Marwala's work has covered topics from economics, as in his recent book *Economic Modelling Using Artificial Intelligence Methods* (2014), to military conflicts, as in *Militarised Conflict Modelling Using Computational Intelligence*, which he co-authored in 2011.

After his PhD, Marwala went on to complete a postdoctoral fellowship at the Imperial College, London, as well as a leadership development course at Harvard Business School. Yet before settling into his career as an accomplished academic, an esteemed author and a beloved mentor to his students, Marwala returned to South Africa to brew beer at South African Breweries (SAB).

To be more specific, he developed an artificial beer taster to evaluate the quality of beer.

"When someone tastes a beer they are tasting all the chemical components – the water that has gone into it, the ingredients, everything," he explains. "How those chemicals come together is important because it affects the pH (acidity) of the beer, the colour and other parameters."

"If you brew a beer and it comes out green it will probably taste different to a golden beer, so colour, for example, is a very important marker of how a beer will taste. And a beer is a system, so if one of the parameters is off, the others are bound to be off as well."

The common approach to assessing beer quality is for human tasters to taste the beer each morning and assign to it a score based on taste and on parameters like colour and pH, which can be measured using various equipment.

Applying artificial intelligence to this essentially means creating an automated system that can predict what score a human taster would have assigned to the beer. To do this, the measured parameters are compared with a huge database of previous scores given by humans. And even though humans have mood swings that could affect scoring, a large enough database will allow an artificial system to generate good predictions on average.

The best case scenario is that an artificial taster becomes more accurate than using human tasters, but it can at the very least be used to supplement quality control tests by humans.

"Theoretically, the artificial beer tester is a machine one can put into a freshly brewed barrel, and which then gives you a statement of how good the beer is based on measured parameters. But removing humans from the process is not done lightly, and there are many safety concerns that need to be satisfied," explains Marwala.

He was involved in the research and development process to generate a prototype, and then moved on to the University of the Witwatersrand (Wits) to continue his academic career.

"The six-and-a-half years I spent at Wits was a very rewarding time. I met a lot of young people, supervised a lot of students," he says.

In fact, Marwala has supervised 19 doctoral students to completion, as well as 47 Masters students, many of whom have gone on to their own successful careers.

"A former student got his PhD from Cambridge, one got a DPhil from Oxford, and another went to Harvard to complete a postdoctoral fellowship," says Marwala. "I had very good students, from South Africa, Africa and the rest of the world – I'm very lucky to work in a field with a public profile, a field that certainly attracts many good students."

He explains that in the 90s, many people thought artificial intelligence, or AI, was just another buzzword that would over-promise and under-deliver,

and eventually disappear. "But just look at the Google search engine," he says.

## ATTRACTING STUDENTS

Since joining UJ in 2009, as the Executive Dean of The Faculty of Engineering and Built Environment, and now in his current position, students from countries as diverse as Jordan, Brazil, China and India have requested to study under him.

"This is the most exciting part for me. It enriches our lives, it exposes us to different cultures and views. When I was an undergraduate student, yes it was cosmopolitan, but it's different when you are a mentor or supervisor. I am fully responsible for those students' stipends, accommodation and well-being, almost like a parent.

"Of course there are difficulties – students get distracted, and you have to push them. But it's fulfilling; it's like travelling the world."

Marwala is not just in demand when it comes to students. "I get all sorts of requests from all over the world, for advice for instance, even from places I thought to be the centre of research in this field."

He points out that such requests began in earnest when he started writing books. "What I've realised is that books make more of an impact than journal papers," he explains. In addition to the over 250 peer-reviewed journal articles, popular science articles, conference proceedings and book chapters Marwala has contributed to, he has authored or co-authored

nine books to date, and one of his proudest achievements is having had one translated into Chinese.

And this articulate writer is also an avid reader. "I like reading outside artificial intelligence, but also non-fiction. In fact I can't recall the last time I read fiction, except maybe Julius Caesar," he says light-heartedly, adding that he particularly enjoys books on the history of science, such as two recent additions to his library, *Sapiens: A Brief History of Humankind* (2014) by Yuval Harari, and *Guns, Germs, and Steel: The Fates of Human Societies* (1997) by Jared Diamond.

When he is not reading, writing or supervising students, Marwala manages research at the university, which involves creating strategies and conditions for academics to fund and conduct their research. He has been in this office for the past three years, and sees his role as ensuring that the University of Johannesburg becomes a leading research institution.

Asked if he still has contact with any of the people he met on that first serendipitous trip to London, Marwala says not really; only a few exchanges here and there over the years. One of these exchanges was a letter that arrived sometime after Marwala had come home barefoot without his belongings in 1989.

It was from a Chicago student who had been in London with Marwala. In the envelope were two photographs of Marwala and the group, so despite the mugging, he does at least have some souvenir of one of the first steps on his journey to success.