

| EUGENE CLOETE |

TOP THREE AWARDS

- Academy of Science of South Africa's Science-for-Society Gold Medal, 2010
- Fellow of the International Water Association, 2010
- Havenga Prize of the *Suid-Afrikaanse Akademie vir Wetenskap en Kuns* (Biology), 2005

DEFINING MOMENT

Reading a book by Edward de Bono as an undergraduate student at the University of the Free State, and feeling a kinship with his ideas about lateral thinking and creativity.

WHAT PEOPLE DO NOT KNOW

I grew up on a farm in the Eastern Cape without mains water or electricity. We had a rainwater tank and I studied by candlelight.



THE SOLUTION SEEKER

Few academics can claim being natural entrepreneurs, but Professor Eugene Cloete is one of them. His curriculum vitae features not just his publications in academic journals, but also almost a dozen patents. He considers his “best idea ever” was using an empty teabag, replacing the tea with activated carbon and using antimicrobial nanofibres for microfiltration to make a filter that cleans water. *Voila* – an innovation that can save lives by making water safe to drink in poor, rural areas.

“I just love ideas,” says Cloete, who since 2012 has served as the Vice-Rector for Research, Innovation and Postgraduate Studies at Stellenbosch University (SU). Whether killing sludge-producing bacteria in cooling towers or cleaning water runoff from cattle feedlots, his talent lies in taking ideas from one field and using them to solve problems in another. In addition to being a Professor and university administrator, he has been and still is involved in science strategy. He has served on a multitude of boards across several disciplines, including the Council for Scientific and Industrial Research (CSIR) and the Water Research Commission (WRC). He has also served on the scientific committee of the Cancer Association of South Africa (CANSA).

His driving force is the desire to make a difference, especially in his own country. He regularly receives excellent job offers from abroad but has decided not to consider these. “The country where I can make the biggest difference with the qualifications and experience that I have, is South Africa,” he says.

EARLY LIFE AND EDUCATION

Cloete’s resourcefulness can be traced back to his childhood. Born in the Eastern Cape he grew up on a dairy farm near Lady Grey, just south of the Lesotho border. He comes from a long line of farmers. Cloete’s father was a very wise man. “He told me to specialise either in food or water, because it is what people will always need,” Cloete recalls.

As a young child on the farm, Cloete’s best friends were the children of the black farm workers. When time came for him to go to the local school, he

was upset because his friends could stay on the farm and play. Only later did he realise that he was the privileged one, who could go to school.

When not at school he would play with his friends on the farm. Once, they built a go-cart using an old ten-horsepower engine mounted on a crate frame with motorcycle wheels. They crashed it a lot. “What impressed me about my black mates was how creative they were, in terms of solving all sorts of practical problems on the farm,” he says.

At school, Cloete discovered an aptitude and fondness for science. He had a keen interest to study biology, but the school did not provide the option to do biology and science, forcing learners to choose between the two subjects. He chose science, because that would get him into a BSc programme. When Cloete went to university, he decided to pick up the biology he hadn’t learned. He enrolled to study microbiology at the University of the Free State, followed by an Honours and Masters degree in botany at the same institution and a DSc degree in microbiology at the University of Pretoria (UP).

During these years he started to see the challenges facing the country, and indeed the world, with regards to water. His father had been right – there were myriad problems to solve in the management and treatment of water. For his Masters thesis, he studied an aquaculture process for treating water run-off from a cattle feedlot housing a thousand cattle. Cloete devised a method to clean the highly contaminated effluent using bacteria-producing carbon dioxide, which in turn spurred the growth of algae that were used to feed fish. The water could then be recycled and the fish harvested as a cheap source of protein.

Cloete started working on his PhD at UP while doing compulsory military service. Thereafter he went to work for AECL, a chemicals company based in Johannesburg, where he completed his DSc in wastewater treatment in 1984.

At AECL, one of the projects he worked on involved controlling bacteria that cause corrosion in industrial cooling towers. The bacteria were nor-

mally controlled with chemicals, but soon the bacteria were developing resistance to these chemicals. He studied and elucidated the mechanisms by which the bacteria acquired resistance. This inspired him to develop a technique that killed the bacteria by 'exciting' the water with an electrical current, increasing the oxidation potential in the water. Due to high oxidative power in the water literally 'incinerating' the bacteria, the bacteria could not build up a resistance. The method was eco-friendly as it didn't use chemicals. The method is now used worldwide, including by companies like Coca-Cola.

ACADEMIC LIFE

Cloete took up a lecturing position at UP in 1986. In 1994, he was appointed as the Head of the Department of Microbiology and Plant Pathology. He stayed at the university until 2008. During this time he served as Chairman of the university's School for Biological Sciences and as Director of its Water Institute.

He also created a 'creativity' institute at the university, named after his colleague and mentor, the British physician, psychologist and inventor Edward de Bono. As an undergraduate, Cloete's worldview had been turned upside down when he'd read De Bono's book introducing the notion of 'lateral thinking'. That is, the practice of taking insights from one field into another to solve problems in innovative ways. "It was quite weird since it was as if he was describing me in that book," Cloete recalls.

A few years later Cloete got to meet De Bono in real life when the author was in South Africa for a visit. The author was interviewed on *Good Morning South Africa*, a TV talk show of which Cloete's brother-in-law was Director. Cloete's brother-in-law arranged a breakfast meeting with De Bono and the two connected instantly. The relationship led to Cloete launching the Edward de Bono Institute for Creativity at UP in 2005.

THE TEABAG FILTER

In 2009, Cloete moved to SU to take up the position of Dean of the Faculty of Science. This is where he had his idea for the water filter – a perfect example of lateral thinking.

Shortly after arriving at Stellenbosch, Cloete learnt about a recent PhD graduate who had developed a method for turning a polymer gel into silk-like fibres using a technique known as electro-spinning. Cloete and two of his postdoctoral fellows used this concept to develop an antibacterial gel that they could spin into nanofibres.

Using emptied teabags as the structure onto which to spin the antimicrobial nanofibres, Cloete and his students then filled the teabag with activated carbon – the cleaning agent in normal Brita filters – and sealed the teabag up again using a student's hair straightener. The filters worked perfectly in the lab.

That was the origin of Cloete's teabag water filter, an idea for which he was nominated for the 2013 Innovation Prize for Africa and featured in the 2010 December edition of *Scientific American* as one of ten world-changing ideas. Since then, the concept has led to the functionalising of nanofibres for numerous applications.

He is passionate about developing people and transforming the racial and gender profile of South Africa's universities. Of the 110 Masters and PhD students he has supervised, over half were women, and 68 were black. "When I look back at my career and I ask myself, what made my career worth something, the one thing that stands out is the students that I've supervised," he says.

Many of his students came from poor backgrounds, and often required some form of personal assistance to get going. "I have taken a lot of chances with a lot of students, and not one has disappointed me," he says. For instance, one of his students, a young woman from the Democratic Republic of Congo, pitched up at his office at UP on a Friday afternoon with her three-year-old son in tow. Cloete put her up in a hotel over the weekend, and the following Monday she became his student. She did a Masters and a PhD with him as her supervisor, and now she works as a Professor at Tshwane University of Technology, and the son has graduated with a degree in electronic engineering from the University of Cape Town.

FIXING THE FUTURE

Work as a Vice-Rector (where he sees his primary role as helping staff and students to become more successful) keeps him busy, but he still manages to squeeze in some innovative work. He currently uses his experience to solve problems in the field of water supply and sanitation. He believes that wastewater is a resource out of place. Dealing with sewage is a grudge activity for municipalities, and requires trained operators that we don't have and hence more than 50% of wastewater treatment plants in South Africa are dysfunctional. However, the main components of sewage – phosphates, nitrates, some minerals and organic matter – are useful resources used in biotechnological processes.

"Current sewage systems turn these resources into mountains of sludge that nobody knows what to do with," he says. His idea is to change the paradigm surrounding sewage treatment, using the resources to produce fine chemicals and other valuable products. This would monetise the activity, creating better sewage treatment solutions and jobs.

He also believes that households need to harvest rainwater, and he is involved in a project testing a rainwater harvesting-and-purifier system based on solar pasteurisation (another good example of conceptual and lateral thinking – based on the age-old process of pasteurising milk), in the Kayamandi informal settlement near Stellenbosch.

He believes that in the future, electricity generation and water provision will be decentralised to the household level, including wastewater treatment. These technologies will be necessary for the world to overcome the challenges facing it, he explains, such as climate change and large-scale human migration. Unlike many others, Cloete doesn't find these prospects frightening.

"I have a very optimistic view of the future, I believe in human ingenuity, I believe in human resilience, and I believe we are at the tipping point that will force us into a new world, a new way of thinking and a new way of doing just about everything. And I'm excited about that, I'm excited about the opportunities," he says with a smile.

