

# ScienceScope

Quarterly publication of the CSIR  
South Africa's Council for Scientific and Industrial Research

Volume 1 Number 4 August 2006

[www.csir.co.za](http://www.csir.co.za)



**WOMEN  
IN SCIENCE**

**CSIR**

*our future through science*

**Foreword**



**Steering women towards science**

**Khungeka Njobe**

THE YEAR 2006 is celebrated as the "Year of the Woman" in South Africa to commemorate the 50th anniversary of the women's march to the Union Buildings on 9 August 1956. These individuals contributed a great deal to raise awareness of the necessity to uplift and empower women as a fundamental aspect towards strengthening our democracy. As we honour these brave women, so too do we at the CSIR celebrate our women in science, and the contribution they make to improve the lives of other people in South Africa as well as raising the profile of women in this field.

Our ability to produce well-trained, effective scientists, engineers and technologists will have an important effect on the levels of innovation and creativity that are so necessary in maintaining continued growth in our country. However, the renewal of human resources remains a challenge, particularly where women researchers are concerned.

**4** **Melissa**  
**Melissa Janse van Rensburg,** research and development metrologist at the CSIR National Metrology Laboratory in Pretoria

**6** **Esbeth**  
**Dr Esbeth van Dyk,** senior researcher in logistics and quantitative methods at CSIR Built Environment in Stellenbosch

**8** **Hulda**  
**Dr Hulda Swai,** senior researcher in polymers, ceramics and composites at CSIR Materials Science and Manufacturing in Pretoria

**10** **Alta**  
**Alta de Waal,** research group leader in socio-technical systems at CSIR Defence, Peace, Safety and Security in Pretoria

**12** **Hina**  
**Hina Patel,** research group leader at the Meraka Institute based in Pretoria, working on ICT for disabilities and the aged





South Africa's future workforce in the arena of science, engineering and technology (SET) will be drawn from the current stock of students, particularly at postgraduate level. One only needs to look at the statistics to note the disparities in gender when it comes to SET. Although women are currently in the majority in terms of enrolments (53%), the more advanced the level of study, the fewer the number of women students and graduates (43% of doctorates). Furthermore, women comprise the majority (75%) of enrolments for doctorates in life sciences and physical sciences, but are under-represented for doctoral enrolments in the natural sciences and engineering (31%).

Within the science councils and government, female R&D personnel make up 42% of R&D staff. However, some important inequities remain, e.g. women are less qualified, they hold less

senior positions, they receive a smaller percentage of research grants, and the majority of scientific papers are published by men.

At the CSIR, 35% of our R&D staff is women, while 10% of our Parliamentary Grant relates to impacts on gender or has a gender-positive approach. The development of a SET career ladder is in process, the results of which I anticipate will not reflect an abundance of women in top science or management positions. There is still no female CSIR fellow, however, for the first time in our history we have a black woman, Nobusi Shikwane, as chairperson of our board, herself a great proponent of the advancement of women.

The constraints that prevent women from advancing need to be understood and addressed, while we simultaneously

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group of CSIR  
Natural Resources  
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Science

## Steering women towards science

need to initiate dialogues with various constituencies – including women researchers – to determine how they perceive the opportunities available to them. The CSIR recently went through a change process, which is not yet complete – we need to consider interventions to accelerate the movement of women through the organisation’s SET career ladder.

It is clear that role models are important to encourage women in advancing their careers. Excellent role models are found in politics and commerce, but we need to actively promote and celebrate those women in science who are pioneers in their fields and who continue to work towards raising the profile of women in their professions. This edition of *ScienceScope* proudly profiles some of the CSIR women, representing those women in our organisation

who are making a difference for the benefit of science and our people.

Women’s Day is an ideal opportunity for us to reflect on how we as an organisation are supporting our women and whether we are drawing on their diversity and unique contributions. The CSIR needs to enhance leadership diversity to provide a broader point of view, support women in balancing their careers and family responsibilities, as well as enhance fairness in selection and promotion processes. We need to aggressively work towards establishing a work force of highly skilled women in SET fields. This starts by raising awareness of the role of SET in society among young girls at schools and universities. The impact of science must become more visible by making SET accessible to all the people of this country.

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**Dr Igile Gledhill,**  
 research fellow at CSIR Defence, Peace, Safety and Security in Pretoria

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**Moira**  
**Dr Moira Bode,**  
 synthetic organic chemist based at CSIR Biosciences in Modderfontein

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**Mwansa**  
**Mwansa Saidi,**  
 research architect at CSIR Built Environment in Stellenbosch

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**Rachel**  
**Dr Rachel Chikwamba,**  
 research group leader in plant biotechnology at CSIR Biosciences in Pretoria

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**Liesl**  
**Liesl Burger,**  
 an optical engineer by profession, based at the CSIR National Laser Centre in Pretoria

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We have made a good start in South Africa: The increase and diversity of women's participation in SET have received attention at national policy level, both within the National Research and Development Strategy and the National Plan for Higher Education. Women have made great strides over the past decade in terms of their participation as postgraduate students and professionals working in SET. Despite positive trends, the fact remains that women in SET tend to be younger and less qualified than men; receive a significantly smaller slice of the rewards and recognition on offer; and are clustered in certain scientific domains.

Perhaps the question is, as science historian Naomi Oakes puts it: "The question is not why there haven't been more women in science; the question is rather why we have not heard

more about them." I hope this publication will inspire aspiring scientists and mobilise women to actively strive to reach their true potential.

– **Khungeka Njobe**  
CSIR Group Executive  
R&D Outcomes and Strategic  
Human Capital Development

Source for statistics:  
*Facing the Facts: Participation in SET, 2004*, published by the Department of Science and Technology and the National Advisory Council on Innovation

Pumla

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**Dr Pumla Gqola,**  
who leads the  
focus area on  
**OpenSpeak**  
at the Meraka  
Institute in Pretoria

Isobel

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**Dr Isobel McDougall,**  
research group  
leader in primary  
processes at CSIR  
Materials Science and  
Manufacturing in  
Pretoria

Valencia

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**Valencia Jacobs,**  
chemical  
researcher  
at CSIR Materials  
Science and  
Manufacturing  
in Port Elizabeth

Lindsay

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**Dr Lindsay Linzer,**  
geophysicist  
in the mining  
competence area  
of CSIR Natural  
Resources and the  
Environment in  
Johannesburg



# Mellisa Janse van Rensburg

## Making her mark in metrology



**“I shrink  
my comfort zones.”**

This statement by Mellisa Janse van Rensburg, spirited R&D metrologist at the CSIR, becomes clear as one realises that this woman means exactly that. She meets her obstacles head on, diverting just enough to equip herself with the correct arsenal to ensure success.



## Tackling the challenges in metrology

Hailing from KwaZulu-Natal, Mellisa lives and displays the qualities inherited from her family – perseverance, resolution and a can-do attitude, while knowing exactly where she is and where she is headed – the diversions notwithstanding.

“I return to work every day because it’s difficult!” she says, somewhat perplexed. “Every day is a challenge. I push the barriers. I try to do something that scares me, and what I do, must be correct.”

Mellisa’s field of expertise, metrology, is the science of measurement and accurate, precise, traceable and equivalent measurement results are key to overcoming international trade barriers.

The economic success of nations depends on their ability to manufacture and trade precisely measured and tested products and services. This entails accurate and reliable measurements at every level of precision, delivered through a sound national measurement system.

The foundation of this system in South Africa is the CSIR National Metrology Laboratory (NML) which keeps, maintains and disseminates the national measurement standards.

The CSIR is mandated by the Scientific Research Council Act (Act 46 of 1988, as amended by Act 71 of 1990) and the Measurement Units and National Measuring Standards Act (Act 76 of 1973, as amended by Act 24 of 1998) to maintain primary scientific standards of physical quantities for South Africa and compare those standards with other national standards to ensure measurement equivalence with the global community.

## Focus on gas metrology to address pollution

At the CSIR, Mellisa concentrates on gas metrology, which entails measurement and certification of gas standards using mainly the analytical technique of gas

chromatography. Gas metrology plays an important role in monitoring pollution gases. For example, carbon monoxide is the toxic gas emitted when fuel is burnt. The only way to know how much carbon monoxide is present in the air at any given time is to first unambiguously separate carbon monoxide from the air in order for it to be measured, and then to compare the amount measured with a known amount of carbon monoxide from a reference standard.

One reason why gas analysis by chromatography is Mellisa’s field of specialisation is her passion for the environment. “I believe that this is my way of contributing, however obscurely, to making our country a better place to live in.”

Gas analysis by chromatography was, however, not her intention when she set out, but rather a sure conviction to obtain an education. After obtaining a BSc in chemistry and cell biology, Mellisa started off by teaching science to senior learners and then university students. She moved on to industry and it was only here that she started dabbling in gas chromatography and mass spectrometry.

“Gas chromatography chose me,” she says. This field became a specialisation and her MSc thesis, titled “The analysis of trace amounts of oxygen, carbon dioxide and carbon monoxide in nitrogen using gas chromatography,” testifies to this.

## Sound advice

Her father is her role model. He taught her to look beyond a person’s gender, colour and circumstances and not to allow hers to become an excuse. Never having had the opportunity to acquire an education, he instilled in Mellisa the belief that education is the cornerstone of a fulfilled life. People might let you down, but “you can take your education anywhere”.

Equally strong is her belief that every scientist should have at least two areas of specialisation. Another diversion, and a

goal which she has lately set out to reach, may even influence her PhD in the foreseeable future.

## A detour into spectroscopy

Although the PhD is definitely on the cards, a small detour into the field of spectroscopy now winks. With no background in lasers, Mellisa is set to help build a cavity ringdown spectroscope, which will use lasers to analyse low concentration impurities in gas. For this she needs to study spectroscopy and gain all the practical knowledge for a second field of specialisation.

Of course spectroscopes are available and expensive, but building a customised spectroscope for gas analysis is certainly a challenge for this woman who would probably sit through a Hitchcock thriller without blinking an eye. The thrills are best experienced at work.

“We are limited only in our own minds. If you think you can’t do it, you won’t,” she explains.

Being only at the start of her career, Mellisa has already demonstrated that her vision is limitless – in fact, watch this space.

– Patsy Scholtz

## GAS CHROMATOGRAPHY

Gas chromatography is a separation process where a gas in which the sample (a mixture of gases) is transported, called the mobile phase, is forced through an immiscible stationary phase that is fixed in a column. Some components of the mixture are more strongly held by the stationary phase than others and move more slowly through the column. It is these differences in the rate at which the components move along the column that result in separation of the components of a mixture as they exit the column.

## SPECTROSCOPY

Spectroscopy is the general term for the science that deals with the interactions of various types of radiation with matter. Cavity ringdown spectroscopy (CRDS) is based on measuring the decay time of light in a very high reflectivity cavity. In the absence of an absorbing gas, the light in the cavity takes a long time to decay after the incident beam (from, for example, a diode laser) is shut off. The decay time decreases when an absorbing gas is present and is dependent on the identity and composition of the gas in the cavity.



**Esbeth van Dyk**

## Pioneering her way to the forefront of agro-logistics



**“Daddy, what comes after 10 and 20 and 1 000....?”**

It was probably these questions that launched pre-schooler Esbeth van Dyk into a career in agro-logistics. Today, senior researcher in logistics and quantitative methods at the CSIR, Dr Esbeth van Dyk has carved a niche for herself in agro-logistics both nationally and internationally, after years of groundbreaking work.





### An early start to her career

Esbeth remembers being brick-high and pestering her dad to teach her to count. But not only to 10 and 20 – “to after 100 and after 1 000.” At that stage she also worked, or rather played, her way through mathematical exercise books while other kids her age amused themselves with dolls and toys.

Predictably, mathematics was Esbeth’s favourite subject at school. Not pure or theoretical mathematics though, she wanted to do applied mathematics – something to help solve the problems of the world.

At university she was introduced to operations research and immediately knew that this was the field for her. She went on to obtain a PhD at the University of Sussex in the UK and served as a post-doctoral fellow at one of the largest pharmaceutical and agricultural companies in Europe. Upon returning to South Africa, she lectured at the University of Stellenbosch before joining the CSIR as a supply chain and logistics analyst.

### Local and international recognition

It was at the CSIR that Esbeth found her niche. For the past six years she has been specialising in agro-logistics. This field, focusing on logistics and supply chains within the agricultural sector, did not exist in the CSIR previously. Esbeth has also managed to establish an expert group that is now widely recognised as a source of agro-logistics knowledge by, amongst others, the Department of Agriculture, the Agri-Business Chamber and various agricultural sub-sectors.

Explaining her decision to focus on agriculture, she says that while there is not much manufacturing in the Western Cape, the agricultural sector contributes substantially to the economy and is a source of employment for many. Her decision was also influenced by interaction with the TNO Inro (the CSIR’s sister organisation in the Netherlands) that is active in this field.

Esbeth’s decision has since proved to be a good one, and she is increasingly being recognised internationally as a leading specialist in agro-logistics. The impact

of her research has also brought her closer to her childhood goal of applying mathematics to the benefit of the world.

### Agro-logistic projects across sectors

Recent projects in which she has been pivotal include serving as traceability expert in the small and medium enterprises (SMEs) sector in Tanzania. The project, managed by the Danish Technology Institute, aimed to improve access of SMEs to international and domestic markets.

Nationally, she has also acted as project manager and technical leader in a National Fruit Logistics Infrastructure Study for the South African fruit industry. The aim of this study was to enhance the competitiveness of the local fruit industry by promoting effective and efficient logistics operations amongst all the roleplayers in the fresh-fruit supply chain, and by making recommendations for the use of and investment in logistics infrastructure.

Esbeth is currently working on an exciting project for the South African wine industry. This involves a foresight study, which could change the wine industry from being reactive and supply-driven to proactive and demand-driven. Whereas wine masters generally focus on producing the wine first and then trying to market it, the study promises to provide producers with precise knowledge on demands with regard to aspects such as market and preference.

This project already holds promise of international collaboration – a dream close to her heart. “I am excited about the opportunity of doing more research at the CSIR,” she says.

With the organisation’s renewed focus on research, she believes it will be easier in future to form international research alliances. “I hope to do more international collaborative research projects, such as with the TNO and the Technical University of Delft in the Netherlands, CIRRELT in Canada and Georgia Tech in the USA.”

Esbeth is also excited about broadening her horizons and expanding her

expertise into other sectors in the agricultural industry, such as sugar and grain, to eventually work across the entire spectrum of the South African agricultural industry.

### Adding some balance

The same zest for knowledge still rings true. Despite having contributed to almost four dozen publications and reports, and having been honoured with four awards and medals over the past five years, she still wants to know and do more.

She admits that she keeps way too long hours. “Everybody keeps telling me that.” But she counters that immediately by bringing out her entertainment spike. “This is where I keep my entertainment tickets.” A collection of cinema and theatre reminders (proof?) that she is trying to live a more balanced life, all arranged neatly and, of course, chronologically, on a metal spike.

Her love of the theatre and music has been nurtured from an early age by her mother. She has taken her to choir and orchestra recitals since pre-school, an activity they still enjoy today.

Her mother was also her mentor, since she lost her father at an early age. She remembers this encouragement with affection. “She often says she never had to tell me to do my homework or study for exams. On the contrary, she would have to ask whether I hadn’t done enough yet,” she says.

Esbeth’s thirst for knowledge is also evident in the fact that she is proficient in four languages – English, Afrikaans, Dutch and German. About French she modestly says that she “can decipher some technical stuff with some effort...”

Indeed a rare combination of mathematics, language and art, which are generally regarded as left and right-brain skills. She shrugs it off as being able to understand the syntax. For the rest, she just concentrates on acquiring the vocabulary.

And while it seems that nothing is too difficult for this diverse and successful woman, she maintains that aspiring scientists must just “go for it”. “There is no reason why you shouldn’t pursue a career of your choice,” she says simply.

Esbeth did exactly that. – **Patsy Scholtz**

## LOGISTICS AND QUANTITATIVE METHODS

The Logistics and Quantitative Methods (LQM) group of CSIR Built Environment has a long history of providing decision-support services to its customers and in the last couple of years there has also been a strong focus on logistics and supply chain management. The underlying strength of the unit is its scientific approach to problem-solving using mainly quantitative methods. The core competencies of the unit are the following: logistics and supply chain management strategy development; centre-of-gravity analysis; channel analysis, supply chain design; distribution strategies; inventory control; demand forecasting; network strategies; outsourcing; warehouse strategies; location/allocation models; simulation and optimisation of the supply chain or elements thereof.

Hulda Swai

## Nanotechnology to improve treatment of diseases



Infectious diseases such as tuberculosis (TB), malaria and HIV/Aids contribute significantly to the high mortality rate in Africa.

While research into and development of new TB drugs, in particular, have languished under a perceived lack of need in the developed world, the CSIR has brought together a consortium of universities and research institutions to address this crucial issue. Led by Dr Hulda Swai, a senior researcher in polymers, ceramics and composites with CSIR Materials Science and Manufacturing, the consortium is developing a nanoparticle-based drug delivery system to improve treatment of infectious diseases.





## Revolutionising drug delivery

Hulda, who has been leading the initiative since 2002, explains that the drawbacks of conventional treatment of infectious diseases called for the development of a delivery or carrier system to release drugs slowly, over extended periods of time. The new nano-drug delivery system addresses a number of key issues, such as patient non-compliance, toxicity, dose frequency, length of treatment and low bio-availability of drugs. It also aims to reduce the cost of treatment.

"In a developing/transitioning country such as South Africa, the majority of people are poor and have to travel long distances to reach their nearest clinic or medical facility," she points out. "As a result, it is very difficult to monitor patients, and health workers are confronted by a high incidence of patient non-compliance, leading to failure of the DOTS programme." (DOTS stands for directly observed therapy short-course, a TB treatment programme developed by the World Health Organisation). The new drug delivery system aims to shorten the duration of treatment, which will substantially improve patient compliance.

Once optimised, the improved delivery process has huge potential to be used in pharmaceuticals, not only in the case of TB, but also for the treatment of malaria and HIV/Aids. Improved drug delivery will impact on a range of socio-economic issues, including economic growth and poverty reduction.

Hulda's interest in drug delivery was sparked while completing her PhD and working at the University of London in the late 1990s. "I was involved in the development of an anti-fungal slow-release device for HIV/Aids patients infected with *Candida*. This project made me aware of how useful polymer technology could be in addressing a number of key challenges in the treatment of infectious diseases," she recalls.

## Successful encapsulation

Her team has managed to nano-encapsulate an anti-TB drug (isoniazid INH) in a biodegradable polymer with particle size ranging from 100 to 290 nm (the required size for oral or pulmonary nano-drug delivery), through the double emulsion solvent

evaporation method.

They have also performed cell studies, which indicated that the cells take up these polymeric nano-particles. The team is currently initiating animal studies with the Medical Research Council in Stellenbosch and Pretoria.

The CSIR, in collaboration with a Swiss university, École Polytechnique Fédéral de Lausanne (EPFL), has explored other polymeric systems with particles ranging from 20 to 80 nm in size. Two anti-TB drugs, INH and Rifampicin, were encapsulated in these polymeric systems. Based on the *in vitro* drug release assays, it was demonstrated that the encapsulated drugs are released at a slower rate and for a prolonged period of up to 10 days, when compared to the free drugs.

To take the mode of delivery to another level, Hulda's group is also working on targeted delivery of the drug with Nottingham University and Cardiff University in the UK. This means the particles will be modified to allow their targeting (localisation) to specific tissues or cells. "If successful, this approach will enable increased bio-availability and targeted delivery, thereby reducing side-effects," she points out.

## Partnership, mentorship and development of people

Hulda has been lauded for building up a large network of national and international partners to participate in the project. She has also been highly successful in securing funding for the initiative, and is in the process of submitting proposals in this regard to the Wellcome Foundation, the Gates Foundation and a Swiss funding institution.

Training African scientists in this vibrant field of nanotechnology is at the top of Hulda's list of objectives. She currently mentors five researchers working on the project and takes personal responsibility for their guidance and training. "Human capital development is one of our key focus areas, with researchers being trained at the University of London, the Swiss Institute of Technology (EPFL), the Nottingham School of Pharmacy, the University of Pretoria and the University of

## WHAT IS NANO?

A nanometre (nm) is a unit of measurement equal to a billionth of a metre, tens of thousands of times smaller than the width of a human hair. The prefix "nano" comes from the Greek word meaning "dwarf".

A micrometre ( $\mu\text{m}$ ) is a unit of length equal to one thousandth ( $10^{-3}$ ) of a millimetre or one millionth ( $10^{-6}$ ) of a metre.

Nanoscience is the study of the fundamental principles of molecules and structures with at least one dimension roughly between 1 and 100 nm. It is concerned with materials and systems of which the structures and components exhibit novel and significantly improved physical, chemical and biological properties, phenomena and processes, due to their nanoscale size.

Nanotechnology is the application of nanoscience in technology devices. The essence of nanotechnology is the ability to work at the molecular level, atom by atom, to create large structures with fundamentally new molecular organisation.

KwaZulu-Natal," she says.

The project has attracted significant international interest, including an invitation for Hulda to address the EuroNanoForum in Edinburgh in 2005. She also accompanied a high-profile South African delegation to a bilateral workshop in the UK early in 2006.

## No mean feat

In conversation with Hulda, the word "focus" comes up repeatedly. A modest, soft-spoken woman, she seems to have thrived on the challenge of combining motherhood with a demanding career, raising three children while studying part-time towards her PhD and working at the University of London. It was during this period in her life that she was inspired by her fellow women scientists from the United States, Africa and Europe. "Working with women scientists at the top of their profession made me realise that instead of being held back by your gender, you should use it to your advantage. I believe you can achieve anything you set your mind to, as long as you remain focused."

In line with her personal philosophy, Hulda's future plans are not modest – she aims to establish an internationally-recognised multi-disciplinary research platform for drug delivery in all areas of treatment where non-compliance remains a challenge. Considering what she has already achieved, this goal seems well within her reach.

– Deidre Lotter

## Predicting uncertainty

Alta de Waal

### THE REVEREND THOMAS BAYES (1702 – 1761)

Bayes was an English theologian and mathematician who was the first to use probability inductively and who established a mathematical basis for probability inference. This is a means of calculating, from the frequency with which an event has occurred in prior trials, the probability that it will occur in future trials. Bayes set down his findings on probability in his "Essay towards Solving a Problem in the Doctrine of Chances" (1763), published posthumously. This work became the basis of a statistical technique, now called Bayesian estimation, for calculating the probability of the validity of a proposition on the basis of a prior estimate of its probability and new relevant evidence.

It was only in the 1980s that the Bayesian Network theory was developed and formalised, notably by Judea Pearl.



From an early start as a high school cricket statistician, Alta de Waal of CSIR Defence, Peace, Safety and Security is now active in the field of decision support, specifically concerning problems with high levels of uncertainty. The systems she works with focus on applying structured modelling approaches associated with quantitative sciences in a multidisciplinary environment.



### Starting with the cricket score

Her interest in statistics and modelling began at high school when she started keeping the cricket score for the high school team. Not only did she keep the score, but she also started keeping all the statistics involved in a cricket match, such as segmentation of the cricket pitch to show where the batsmen hit the most balls, their averages, history of their cricket careers, and so on. She reminisces, "I liked doing this and I developed an interest in statistics. If you have all this information, what can you do with it? This is where I started to think about modelling. Can the statistics be used to model or predict the outcomes of a game? By analysing the data you become familiar with it and start to see patterns. I needed to find a way of expressing the patterns I saw in the data – that is where my interest in modelling started."

Alta is the research group leader for socio-technical systems, which falls under systems modelling. She started working at the CSIR in 1999 in the field of decision support. Her first mentor at the CSIR was her colleague and former manager, Dr Jan Roodt, who opened up opportunities for her. She did her MSc in mathematical statistics at the University of the Free State where she was a part-time lecturer before joining the CSIR.

### Those excellent Bayesian Networks

"What makes me tick are the methods that allow one to structure these high levels of uncertainty, one of which is Bayesian Networks, or BNs," she says. It is an excellent way to communicate knowledge to a computer in order to process the knowledge and obtain answers to queries about the area of interest. BNs are com-

plex diagrams that organise the body of knowledge in any given area by mapping out cause-and-effect relationships among key variables and encoding them with numbers that represent the extent to which one variable is likely to affect another.

One of Alta's areas of specialisation is applying BNs in the field of cyber forensics, which is the forensic investigation of electronic data. Forensic science requires the ability to deal with uncertainty, as evidence is always incomplete to some degree. The significance of evidence in the light of competing claims and the background knowledge of the case must also be taken into account. This field of research surfaces issues such as co-reference of actors and record linkage – all of which are cutting-edge research in the field of applied BNs.

When Alta works on a project, she finds the start of an investigation an essentially "messy" situation. "Most of the areas that I work in start off with a mess and high levels of uncertainty," she notes. "BNs help me structure the mess into an understandable graph and manage the uncertainty. It is exciting to experience the progress from chaos into a structure. But most of all, BNs are not static models; they also provide answers to questions and assist in deriving logical conclusions from the knowledge in the models. This is called inference."

Alta uses BNs as a modelling technique to elucidate sensitive variables in problem areas. This means that users understand the complex chain between cause and effect associated with a particular problem area. Alta's own impact covers a wide range in the fields of the military, peace support, vulnerability towards water-borne diseases and training for rescue services.

### What is a socio-technical environment?

A socio-technical environment is where one would find social structure, in other words, an organisation or a network of people. The people factor is very strong, but there is also a technical component, such as the processes or hardware that need to interact with the social component.

"When you work with a social system, it looks very fuzzy and it's qualitative and messy," she warns. "However, a BN is a very good way for people to communicate about a system, for example, vulnerability to cholera: in this case there's the social component, namely the villagers who are exposed to the disease, and the technical component, which is the intervention, such as supplying people with toilets, clean water or access to clinics. This is a very complex system because there are so many interactions between the elements. BN helps show up the important factors of the system: a graph is produced that gives people common ground to communicate about the system. The graph can then be communicated to a computer so that the computer will understand the communication between people."

### About science and scientists

The Reverend Thomas Bayes has had the greatest influence on Alta's work, and she is inspired by any scientist who has a solid scientific basis and whose work has had substantial impact.

Alta is working on her PhD, which deals with the surfacing of information that can contribute to forensic evidence. She is also interested in applying BNs to model social networks, for example terrorist networks, political and commercial organisations to understand the connectivity between actors and the flow of information. This has several applications, such as planning interventions, understanding the sphere of influence of actors, and optimising the network and communication between them.

Her vision is to make a difference in people's lives through science: "Science itself is not the goal: it's a means to achieving your ends." Alta quotes Albert Einstein, "We should take care not to make the intellect our god. It has, of course, powerful muscles, but no personality. It cannot lead, it can only serve."

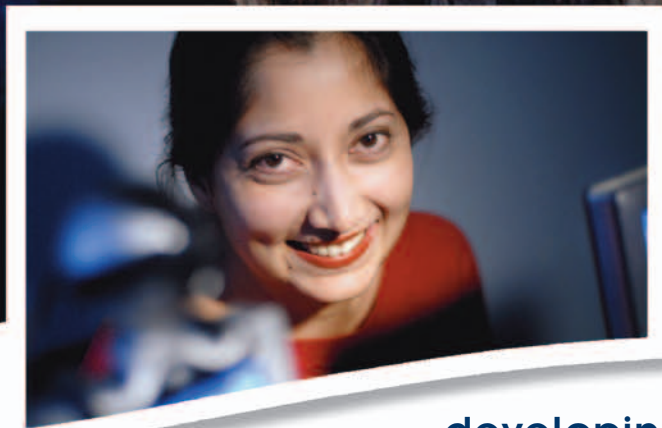
Her advice to women who wish to start a career in science is, "You must find your passion and then grab every opportunity to develop it into a useful skill. Build your networks, talk to people and communicate your work."





# Changing the disability landscape

Hina Patel



**A commitment to inclusiveness and a passion for developing the potential in people underpin Hina Patel's words and her work.**

As the leader of the research group at the Meraka Institute working on ICT for people with disabilities and the aged, she is engaged in two long-term R&D projects aimed at improved quality of life for persons with disabilities.



### **"Nothing about us without us"**

The National Accessibility Portal (NAP) initiative addresses the information and communication needs of persons with disabilities and considers how to create an enabling environment in a South African context. From the outset, the conceptualisation and planning of the NAP project included persons with disabilities, Disabled Persons Organisations (DPOs) and the Office on the Status of Disabled Persons (OSDP) in The Presidency through workshops and other mechanisms.

Hina has appointed six people with disabilities to the Meraka Institute as part of the NAP team. "Two staff members are blind, one is a person with quadriplegia who cannot speak and three members are deaf," she explains. "Each is a fully functional member of the research team."

She is clear on the benefits of this strategy, "Their contribution is invaluable, as it brings diversity in its purest sense." The unbounded creativity of their ideas, their technical expertise and their domain know-how bring clarity and understanding of requirements to the initiative, based on their first-hand experience.

In the spirit of "nothing about us without us", NAP is undertaken collaboratively: networking and interaction with stakeholders, partners and users is an integral part of the project. It has been informed and shaped by several significant policy frameworks and interventions: the World Summit on the Information Society (WSIS) Declaration of Principles, the National Integrated Disability Strategy, the No 6 White Paper on Inclusive Education and calls for participation in EU Framework 6 agreements for projects focusing on accessibility for persons with disabilities.

Endorsed by Dr Essop Pahad, Minister in The Presidency, the initiative was part of the Meraka Institute exhibition at the WSIS in Tunisia during November 2005, where it drew the attention of State President Mr Thabo Mbeki.

### **Making a difference through people and research**

Hina's interest in people from all spheres and in different groupings manifests itself in a passion for making a difference coupled with a calm and encouraging manner.

Questioned about the inclusion of the aged as a topic of research, she explains, "The aged has been identified as a grouping that can contribute positively to society. Advances in medical and other care have resulted in increased longevity, and many countries are raising the retire-

ment age." The needs of this group are currently the topic of the Enabling Environment research project within the Meraka Institute.

Currently, NAP researchers are engaged in fields of study ranging from sign language, the enabling environment and augmented reality to social and cultural aspects. "Research aimed at enhancing human-computer interactions is a recurring theme in this field," confirms Hina. NAP and the enabling environment projects are aligned with the Meraka Institute mission where research and innovation to address improved quality of life provide a framework for people development. The development of affordable open source alternatives for assistive technology is another important objective.

Her work on NAP has been recognised by The Presidency and she travels world wide to promote research collaboration with other groups working on accessibility. Commenting on progress to date, she confirms that the online presence of NAP version 1 was launched during July 2006. The HP i-community centre in Mogalakwena, Limpopo, will be the venue for a NAP deployment sometime in August or September 2006. She says, "Making this version available for testing by the various partners in the initiative, including the Department of Education in Limpopo, is an essential step in its continuous development and refinement."

She is quick to point out the complexity of the NAP initiative, which requires that it should cater for all disabilities in all official languages (including Sign Language), particularly through R&D of affordable technologies and devices. The initiative therefore makes use of social trainers to help users and has devised an ingenious process to ensure that surrounding communities are exposed to and can contribute to the NAP project. "We must make every attempt to engage with communities," she says candidly. "Although we know that at least four million people are living with disabilities in South Africa, it is not always clear where they are to be found."

For NAP to make a difference, sustainability is crucial. Speaking about the long view for NAP, Hina says, "With our target of 27 sites in the nine South African provinces by 2009, investigation into sustainability models is of the utmost importance." A sustainability expert from the UK will join the team to assist in exploring sustainability models through a diverse set of research activities.

Hina has always been interested in ICT for development. To her, the appeal of being part of the NAP team is vested in its

potential to achieve a significant improvement in the lives of persons with disabilities and the aged, "I would like to assist in bringing about a substantial change in the disability landscape and contribute to assisting people towards achieving independent living through R&D." She has a BSc (computer science) from the University of Royal Holloway and a National Technical Diploma in computer studies and electronics from Merthyr Tydfil Technical College in Wales.

### **Behind the scenes**

Hina's confidence and drive to achieve her vision is clear in all she says. "No challenge is too big to tackle." Her passion is for people, "People development is what drives me. I believe that I can see the possibilities to reach and transform the potential in every individual."

She is drawn to the concept of leadership and credits the Advanced Leadership Programme of the CSIR with helping her to develop a toolkit of life skills. "I got to know myself better," she confides. "I also established relationships with people throughout the CSIR, which have been invaluable ever since."

Explaining what it is that makes her take on increasing responsibility within the Meraka Institute, she says, "I have learnt that I can make things happen; I can lead, I can develop people." She is drawn by the complexity of people to drive, guide and look after those with whom she deals on a daily basis.

Leaders who have achieved a great deal, despite extreme difficulties, are her role models: Mahatma Gandhi, Jomo Kenyatta, Nelson Mandela and Thabo Mbeki, and women such as Indira Gandhi. She comments, "Leaders influence me: their style and elements of what they do."

Hina's favourite quotation epitomises her belief in herself and in those around her to achieve: "Great people are ordinary people with an extraordinary amount of determination." (John Maxwell)

Her advice to younger women starting out is, "Go for it – just do it! Women have excellent qualities to succeed in this field: our communication and people skills are inherent advantages."

### **What lies ahead?**

Hina's vision is a desire to effect a significant change through ICT in the disability landscape, with her research group. She highlights the importance of strategy and goals aligned with the New Partnership for Africa's Development and the Africa Decade of Persons with Disabilities.

**– Biffy van Rooyen**

# Caren Jarmain

## Toiling in pursuit of top research data



**“You probably have to be a bit of a tomboy to survive in this field.”**

Dr Caren Jarmain's field trips have taken her from the Kruger to the Cape. Her mission: researching the evapotranspiration of vegetation canopies – finding out how much water a defined area of vegetation uses. This has taken her to some of the most scenic places in our country, but it has also resulted in close encounters with snakes, spiders, buffaloes and she recently contracted tick fever when working in northern KwaZulu-Natal. Her determination to carry as much gear as her male colleagues on a field trip has earned her the reputation of being somewhat of a tomboy, which her husband has assured her, is a compliment.



### One in a million

Agrometeorology and micrometeorology are exciting and challenging fields that can contribute significantly to sustainable development in South Africa. But there are not many of her kind coming through the system. Caren was the first person in four years to have majored in agrometeorology at the University of the Free State when she graduated in 1998. Today, as she searches for trainees to work with her in this field, she shares the concern of her colleagues: Where are our future scientists who study the relationship between climate, the environment and our vegetation?

"Part of the challenge," Caren says, "is that agrometeorology requires a unique combination of skills not often found in a single individual. Many principles in this field are rooted in physics. I remember how pleased my fellow BSc Agric students, who did not opt for agrometeorology, were that they did not have to do physics. To boot, you need to be clued up on electronics, as you have to install, operate, and trouble-shoot a range of

instrumentation – from an automatic weather station and a variety of sensors installed above and below ground to a power generator. You have to enjoy working outside. You need to be practical and should, for example, be able to design a mounting structure – which might need to be mounted over a very tall canopy such as trees, and sometimes over low grassland canopies. The intensity of measurements implies that masses of data are collected and have to be analysed, so an affinity for working with data is required too."

A neat pattern of *cum laude* degrees, publications and scientific paper listings litter her CV. Caren has found her niche specifically in techniques relating to plant-soil-water relationships and in the interpretation of data collected using these techniques. She focuses on techniques to determine the evapotranspiration of a canopy of plants, for example, a plantation of trees, an invader strip of riparian vegetation, a large fynbos stand or a sugarcane field.

Her research has many applications. Decision-makers in the mining industry want to know whether some vegetation types can contain pollution, which has led to research on the water usage of plants on top of slimes dams. The South African forestry industry needs to determine the amount of water used by forest plantations. Water resource decision-makers use data on the water use of invasive and indigenous plant species in hydrological studies on stream flow reduction activities.

### How does one decide to become an agrometeorologist?

Caren has always been fascinated by nature and its processes. She looks back with gratitude on an excellent geography teacher who was instrumental in opening

up this world for her. But the aptitude tests pointed to her becoming a speech therapist, while her father regarded a BComm degree as "a decent choice". Their compromise was a BSc Agric because agricultural economics was a first-year subject. "But within the first six months I was exposed to agrometeorology and that settled it!" she recalls.

Caren says that most people understand the concept of measuring how much water a canopy of plants uses, but they do not understand how it is done. And when probed about exactly what is measured, Caren tries her utmost to explain to a novice how a simplified energy balance approach takes into consideration net radiation, soil heat flux, latent heat density and sensible heat density and is used to provide an estimate of evaporation.

### The pros and cons

Caren admits that it is not a "convenient" career. "Field work is not a nine-to-five job. The packing and planning for a field trip is a mission in itself. Then one has to travel to the destination and one sometimes spends many weeks away from home, although I try to spend weekends with my husband, who is under strict instructions to remain in a career that does not require any travelling. Fortunately cell phone technology nowadays allows one to download data from remote sites many kilometres away and reduces the frequency of some field visits."

Her job has its challenges and its rewards. Getting everything to work on a field trip is a great feeling and can only be surpassed by the satisfaction of collecting a proper data set! But the disappointment when a flood washes away your entire outstation – destroying equipment of millions of rands, is ghastly – "I hope I don't have to experience that ever again," Caren shudders.

### Get your hands dirty

There are very few women in this field.

"When I presented a paper at the European Meteorological Society last year, I was the only woman presenter in my section," she says. "A woman can survive and flourish, but you have to be physically and mentally strong and be willing to give everything. You have to show that you are prepared to get as dirty as anyone else." – **Alida Britz**

## ABOUT AGROMETEOROLOGY

Agrometeorology is an abbreviation of agricultural meteorology and puts the science of meteorology to the service of agriculture. It is an interdisciplinary science where the main scientific disciplines involved are atmospheric and soil sciences, which are concerned with the physical environment, and plant and animal sciences. An agricultural meteorological station is a collection of sensors connected to a data logger, designed to accumulate several types of soil and atmosphere observations, and report weather variables related to agriculture, representing conditions for a designated area.



# Sibongile Pefile

## Taking science to the people



The passion for science, development and interaction with society rings clear in every idea expressed by Dr Sibongile Pefile, CSIR Group Manager: Research and Development (R&D) Outcomes. "When the CSIR is recognised immediately as the premier South African organisation for supplying both society and industry with quality technology and knowledge, and we are able to maximise the impact of science in society, then we will know that we got it right," she asserts.



## "I chose the CSIR"

On her return to South Africa in 2004 – after a three-year stint in the UK – Sibongile decided that she wanted to join the CSIR. "It was a conscious choice – I wanted to be part of a research organisation that undertakes applied research and produces technologies. I see applied research as those activities that drive knowledge and technologies out of the laboratory into society. That is the space I wanted to occupy: being active in science while interacting with the outside world – industry and society," she explains.

The R&D Outcomes office was established in 2005 as part of the reconfigured CSIR, focusing with renewed vigour on its core activity – research and innovation. This was the ideal position that combined Sibongile's passion and expertise. From being CSIR intellectual property (IP) and innovation manager, she took up the challenge to establish the new portfolio.

## Technology transfer for social impact

Initiatives of R&D Outcomes include the management of IP and technology transfer, with a special focus on technology transfer for social impact (TTSI); the dissemination of academic knowledge; and the impact assessment of the CSIR's research performance. But how can the CSIR go about reaching South African society? "Our TTSI office is responsible for the large-scale roll-out of projects that the CSIR has already piloted successfully, with significant social impact," says Sibongile.

With the Department of Science and Technology (DST), the activities of the TTSI office will focus on three flagship projects to start the roll-out:

- The distillation of essential oils by communities, for example a community-owned mosquito repellent candle factory in Limpopo, where a plant is

being cultivated and distilled and its essential oils used in the manufacturing of candles.

- The provision of a robust computer kiosk – the Digital Doorway – to communities to enable individuals to teach themselves computer skills based on the concept of minimally-invasive education. More than 100 user points have already been installed in a mix of rural, peri-urban and urban areas, providing communities with access to information via the internet.
- Communities growing fresh herbs through hydroponics technology, i.e. growing plants without a soil medium. Nutrients are dissolved in irrigation water and fed directly to the plants in controlled conditions. The Beaufort West Hydroponics Company has already received an award for its role in poverty alleviation.

"The aim is to create industries from these projects; we'll pursue collaboration with other research organisations, and with the assistance from the DST, cooperation with other government departments in the region," Sibongile explains.

The CSIR is also discussing the development of social responsibility programmes to focus on the CSIR's interaction with communities in the immediate vicinity of its regional offices and its main site in Pretoria. "We want to make a difference in our surrounding communities by involving schools, learners and their science teachers, for example by giving them access to knowledge and science resources available at the CSIR," she says.

## A career path in health equity

Born and bred in Swaziland to South African parents, Sibongile completed her primary school education there before being sent off to the UK for her secondary school studies. "I was all of 13 years old; British schooling provided me with a great deal of structure; having to take charge of

my life made me fiercely independent."

She completed her Masters in Pharmaceuticals at Rhodes in Grahamstown in 1997, followed by her PhD at the University of Cape Town. Her PhD studies on medicinal plant and indigenous knowledge systems (IKS) equipped her well for her first position at the Medical Research Council. There she looked at best practice in IKS research, the socio-economic aspects of traditional plants and IKS, benefit-sharing mechanisms and ethical issues, amongst others.

When personal circumstances saw her returning to the UK in 2001, Sibongile consulted on health equity and IP management in health research. "I had great opportunities to interact with people who made decisions about, for example, funding health projects that impacted directly on the developing world. The aim was to provide thought leadership on issues regarding IP and whether or not it inhibits access to medicines and other health technologies needed by the poor. My input as an individual from the developing world was found to be a valuable reality check; it was gratifying to know that I was contributing to issues of development in Africa, even while being away from my country."

## Supporting women in science

What is Sibongile's take on gender issues in the science arena? "I find the strength of women amazing, as well as their ability to tap into this strength to achieve so much, both at work and in their private lives. I do not think about 'levelling the playing field' for women in science – what you regard as a level playing field may not be level to the next person. Instead of talking about 'equality' for women, I believe we need to strive for more than equality; I therefore prefer an environment that is supportive, makes us feel uninhibited and not compromised in any way, while it providing room for progress and achievement."

## Personal development

She loves travelling in Africa and calls India, another one of her favourite destinations, "deliciously chaotic". Real interaction with local people in developing countries, such as bargaining at a local market over the price of items, makes her feel alive.

Sibongile still has strong ties with Swaziland and visits regularly. "It is a country without enough social support for communities; although South Africa has limited social support, it is still much more than what is available in Swaziland. My pet project that I contribute to is a halfway house for abused children in Swaziland; I believe we have to give back to the community that we grew up in." With a mother who has always been a working woman and a father who holds a PhD in business administration and is now completing his second doctorate (at age 71) in HIV/Aids counselling, it is no secret as to the roots of this phenomenal woman's compassion and drive. – **Hilda van Rooyen**



Freda van Wyngaardt

## Radioactive measurement with absolute precision



Freda van Wyngaardt may be soft-spoken and a little reserved, but she can hold her own in the exact field of radionuclide metrology. Freda, a research and development metrologist at the CSIR National Metrology Laboratory, prefers to go about her work without any fuss.



## Maintaining national standards

The Radioactivity Standards Laboratory where she works maintains South Africa's national radioactivity measurement standard through the precise measurement of radioactivity, mainly using absolute methods. Through participation in international comparisons, equivalence of our measurements with those of other national laboratories is demonstrated.

The laboratory provides standards for the calibration of nuclear instrumentation used in nuclear medicine, radionuclide production, monitoring of radioactive pollution and contamination, and nuclear physics research. The calibrated instrumentation enables users to perform reliable and traceable secondary measurements.

## Consistent achievement

Freda is currently doing a PhD on the development of a liquid scintillation counting technique to measure mixtures of two pure beta-emitting radionuclides. This is difficult since the energy spectra of all beta-emitters overlap, and special means

are necessary to resolve such mixtures. A paper, which she has co-written on this work has recently been accepted for publication in the prestigious journal *Nuclear Instruments and Methods in Physics Research*.

Freda views her achievements almost diffidently. She modestly shrugs off the fact that she was awarded a research fellowship in the Women in Science Awards of the Department of Science and Technology in 2004 and has published 11 papers in peer-reviewed journals.

## Success in simplicity

Of her current research, she says that she is using a simple technique, compared to some of the other methods that rely on complicated settings of counting windows or complex computer processing to resolve mixtures. Measurements can also be completed in a short time, compared to another method where samples are counted repeatedly for a long time compared to the half-life of the short-lived radionuclide.

## From dietetics to metrology

Freda started off as a student in dietetics. This was definitely not her field and thanks to an alert lecturer, Freda was launched into chemistry and applied mathematics – fields in which she excelled and today still stand her in good stead.

Joining the CSIR in 1996 almost came naturally. Freda recalls that she lived close to the CSIR in Pretoria all her life and it had been a given that she would one day work at the organisation.

Today she literally works in a stable and is proud of the fact that her office under Table Mountain housed horses some 103 years ago.

She describes her work as a scientist at the Quaternary Dating Research Unit of the CSIR as enjoyable. It was there that she started developing her love of road-running.

## A determination to succeed

So far she has earned medals in six Comrades marathons and she has her eye firmly set on that permanent Comrades number once she reaches the 10th race.

She fondly remembers starting to run with her father. "That was very special. We have completed a couple of Comrades and Two Oceans marathons, the last one stride for stride."

Freda also loves hiking and mountaineering. It was on one of these hiking trips in the Cedarberg that she met her husband, Gerhard, who is an engineer and a nature lover. "Hiking is an activity we both enjoy," she says.

When asked about the future, her determination shines through. She is first going to obtain her PhD and then get that 10th Comrades medal.

In order to achieve her first objective, she has the support of her colleague and mentor, Dr Bruce Simpson. "Most of what I know in the field of radionuclide metrology, I learnt from Bruce. He is an excellent mentor and also my PhD supervisor. His knowledge of and insight into our field of work is outstanding."

And then? "Then it is out of the way," she says quietly.

The Comrades she will tackle once she gets fit again. And Freda will – quietly and with determination.

– Patsy Scholtz



## RADIONUCLIDES

A typical atom consists of a nucleus composed of protons and neutrons; with electrons in orbitals outside the nucleus. A nuclide is any atom with a specific atomic number ( $Z$  = number of protons) and mass number ( $A$  = number of protons + neutrons). This can be described symbolically as  ${}^A_Z X$ , where  $X$  is the symbol of the element. Radionuclides are unstable nuclides that decay to stable or unstable progeny of lower atomic mass by emitting nuclear radiation.

## BETA-EMITTER

A beta-emitter is a radionuclide that decays by emission of a beta particle (an electron).

## LIQUID SCINTILLATION COUNTING TECHNIQUE

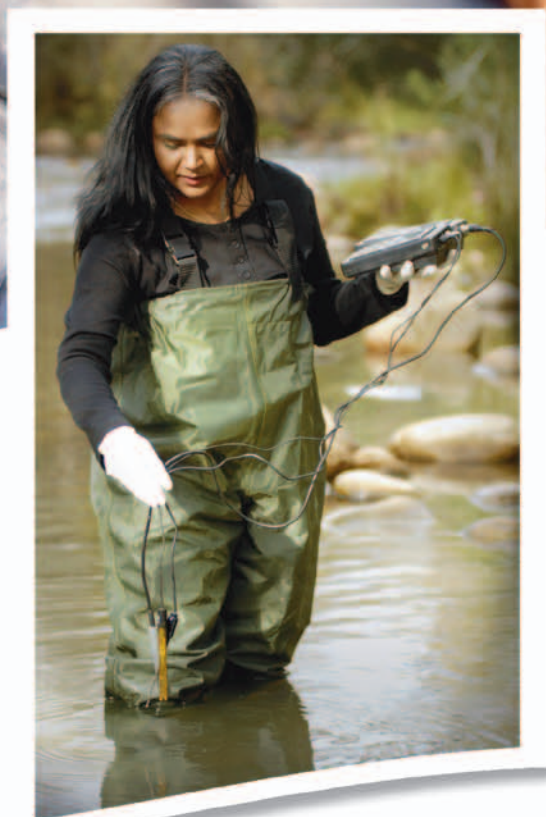
For liquid scintillation counting, a radionuclide sample in solution is mixed homogeneously with a liquid scintillation cocktail that consists primarily of a fluorescent solute (scintillator) in an organic solvent.

Most of the energy of the radioactive decay is absorbed by the more abundant solvent molecules. The excited solvent molecules so formed easily transfer their energy to the scintillator solute. These excited scintillator molecules rapidly lose their energy and return to their original ground state through the emission of photons of light (fluorescence). The intensity of the light produced is a function of the energy and type of radioactive decay.

The light is detected by a photomultiplier tube, which is able to convert the extremely weak light output to an electrical signal in such a way that the output pulse is proportional to the original number of photons.

Joy Leaner

# Combining a passion for science and the outdoors



It all started in a biology class at Excelsior Secondary School some 20 years ago. Back then, it was mere enthusiasm for the subject and a love for the outdoors that made Joy Leaner realise for certain that she wanted a career in environmental research. That energy has since evolved into a passion that is driven by sheer determination and aided by a natural flair and talent. It has blossomed into a PhD at a top university in the USA (courtesy of a Fulbright scholarship), publication in various peer-reviewed journals and a promising career at the CSIR.





### Focusing on river health

Today, Dr Joy Leaner is a research leader for the Water Ecosystems group of CSIR Natural Resources and the Environment – a direct result of the CSIR's renewed focus on core research, as articulated in the organisation's Beyond 60 process.

"I commend the Beyond 60 process for putting an emphasis on research; it certainly has re-opened doors for CSIR researchers," Joy says with an irrepressible air of passion.

Joy joined the CSIR as the water programme thrust manager in February 2002. Most of her energy during that time was devoted to the River Health Programme's State of Rivers Reports in the Western Cape, a project carried out in partnership with the Department of Water Affairs and Forestry (DWAF). "It focused on selected ecological indicator groups that represent the larger ecosystem and are feasible to measure," she says. The results of this study led to the publication of five State of the River reports that were submitted to DWAF's Western Cape provincial government. The provincial government has since initiated an Adopt-a-River programme, aimed at raising public awareness of the state of rivers in the Western Cape.

Many in her position would still have been basking in the glory of the Water Programme – but not Joy. She was recently named the coordinator and research leader for the South African Mercury Assessment (SAMA) programme, and it is with this research that she plans to leave a legacy.

### Eradicating a global water toxin

Although statistics have revealed that South Africa emits the second highest concentrations of mercury pollutants in the world, little research has been done locally to combat its eminent threat. "Mercury is a global toxin, which poses a threat to ecosystems, and more importantly, human health," she explains. Excessive exposure to mercury, especially the more toxic methylmercury form, can lead to neurological and mental disorders, developmental problems and death, since it attacks the central nervous system.

The SAMA programme comprises government departments, as well as

national and international scientists, and aims to develop a framework for mercury research focusing initially on the transport, fate and consequences of mercury from coal-fired power plants in South Africa.

Once this stage is complete, Joy will compile a comprehensive database of all mercury incidences in South Africa. "These databases will be made available to government (locally and to others in the Southern African Developing Community region) and other important policy and decision-makers, to come up with legislation aimed at curbing the dangers of mercury."

While Joy is in a management role, she still relishes the opportunity of being involved in "real" research. With the mercury research project, a typical day comprises collecting samples from the aquatic environment (this ranges from water to fish), using "clean techniques", because mercury levels in the environment are very low in most natural waters. Scientists take extreme precaution when sampling mercury to avoid sample contamination from their hands and clothing.

This entails wearing gloves and hoods, while using stringently cleaned sampling equipment (for example acid-cleaned Teflon bottles or vials) and techniques (such as double bagged samples). In the laboratory, samples are analysed for their total mercury and methylmercury content.

### Knowledge-sharing and mentorship

Besides acing both her BSc Honours and her Masters degrees in zoology, Joy cites being offered the Fulbright scholarship at the University of Maryland, College Park, as her proudest achievement. "It was a rigorous process, and the competition was very tough," she says. She considers her high school biology teacher, her PhD mentor, and retired CSIR Water Programme Manager – Dr Johan de Beer, as the people who have had the most profound influence on her career. CSIR Group Executive Khungeka Njobe is Joy's role model.

Joy is a role model herself. While studying, she was a member of the Society of Naturalists and the Environmental Society, and regularly organised field trips for schools. "The trips were aimed at educating school children about nature on a first-hand basis," she says. "This was

long before Outcomes-based Education was introduced in schools, so I guess we were way ahead of our times!"

She urges up-and-coming young women to believe in themselves, and to not only grab the opportunities that present themselves, but to create them as well. "The world is your oyster – strive for success – and accept nothing less than the best," she adds.

### Conquering the world out there

While the SAMA programme will keep Joy occupied for quite a while, she also plans to travel and see the world with her husband. She loves the outdoors, and is an avid mountain biker, bird-watcher, scuba diver and hiker. "My ultimate dream is to conquer Kilimanjaro," she says confidently.

"It's all about passion, and having a positive outlook on life," Joy says. "I believe that you will have a better tomorrow, provided you take care of today," she concludes with a radiant smile.

– **Thlogi Mokhema**

## MERCURY AS A GLOBAL POLLUTANT

Mercury is a naturally occurring element that is mainly released into the natural environment by volcanoes, natural mercury deposits and volatilisation from the ocean. Human activities such as coal combustion, chlor-alkali processing, waste incineration and metal processing also contribute to the mercury found in the environment. However, the ultimate source of mercury in most aquatic ecosystems is deposition from the atmosphere, primarily associated with rain.

Mercury occurs in three basic forms: elemental (metallic), inorganic and methylmercury. All forms of mercury are toxic, but methylmercury raises concern because our bodies have no defence mechanisms against it.

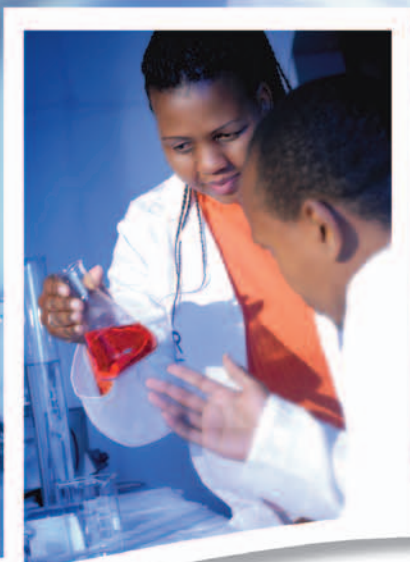
This more toxic form bioaccumulates in aquatic food chains, and usually the larger predatory fish such as tuna, shark and swordfish carry the highest concentration of methylmercury in muscle tissue. Once ingested by people, methylmercury is rapidly absorbed in the gastrointestinal tract and easily penetrates the blood-brain and placental barriers.

Women of child-bearing age, pregnant women and children are therefore considered high risk. Symptoms of methylmercury poisoning include neurological disorders, developmental problems, reproductive disorders, disturbances in sensations, impairment of speech and vision, hearing and walking difficulties, mental disturbances, and in some cases death.

The most well documented cases of severe methylmercury poisoning are from Minamata Bay, Japan in 1956 (industrial release of methylmercury) and in Iraq in 1971 (wheat treated with methylmercury fungicide). In both cases, people died or suffered permanent damage. Most studies in South Africa have been reactive, with probably the most well-known case of mercury poisoning being that of the Hg-contaminated effluent spill into the Mngceweni River, KwaZulu-Natal during the 1990s.

Yoliswa Kula

# No guessing on food safety



She comes from a family of teachers, nurses and electricians – practical, valued professions. “But what does one do with a BSc degree?” they asked when she finally enrolled at the University of the Western Cape, having completed her matric a year later than planned as a result of the 1985 student riots, which prevented her from writing her final exams.



From their initial unease with her choice of qualification, her family today admires the uniqueness and the value that her job adds to everyday life. They now phone her to find out what brand of olive oil is the purest; what the story is behind the Sudan Red colourant in curry powder and which baby food is the most nutritious. Meet Yoliswa Kula, biochemist by training, and formidable manager at the CSIR Chemical Analytical Laboratory in Cape Town.

### What's on that label?

The laboratory undertakes chemical analyses of foodstuffs – anything from beverages, animal feed, fish and processed foods to fruit and vegetables. Yoliswa explains that these tests can answer questions such as: How much dietary fibre does a product contain? Are there any preservatives present? What percentage of the product is fat? What is the breakdown of the fatty acids? Are there any toxins in the shellfish?

The desire to know the exact composition of foods, and for guarantees on their quality, is gaining prominence world wide as both consumers and governments become increasingly conscious of food safety and health issues. In South Africa, proposed new labelling regulations have been drafted and many prominent food producers have started applying some of the proposed labelling practices. A prominent food manufacturer may for instance decide to market a product with specific health benefits and would need to test the foodstuffs to make these claims.

Another need for the chemical analysis of food springs from South Africa's status as a sound food exporter. For local exporters to sell their products abroad, strict international requirements have to be met.

### Experience counts

As with most professions, experience is a key aspect and this is what makes a good analytical chemist. Says Yoliswa, "When you sample a product of which you will – for example – measure the percentage of moisture, an experienced analyst would immediately recognise an incorrect result, based purely on the sample matrix. Sample preparation sounds basic, but it plays an important role in the analytical process. For example, if the sample – say a cooking sauce – is not properly homogenised, the result will be compromised." Having worked in the laboratories of Nestlé, KWV and Colman Foods before joining the CSIR in May 2001, Yoliswa has experience aplenty and today she is in a position to share this with junior staff.

### Focusing on the client's needs

Her respect for clients, their food samples and their results, is a golden thread in a conversation with Yoliswa. "The information we provide is what our clients print on their labels. There is no room for mistakes: it is not an approximate science. All tests are duplicated, checked by a senior analyst and if the slightest doubt exists, the technical manager checks the results."

Yoliswa finds giving advice to novice clients extremely rewarding. "Unlike experienced food industry players who know exactly what they need, we also serve people who have been experimenting in their kitchens and are keen to take their products to retailers. Somewhere along the way, they hear that nutritional analysis is a requirement, but they don't have a clue how to go about it. It gives me enormous pleasure to share my experience in the broader food domain," she says.

### Coping with pressure

It's not an easy job and Yoliswa has her fair share of stress. Time pressures are

extreme, as clients often leave too little time for the analysis of their products. In the fishing industry, a container of fish has occasionally been shipped to its destination prior to receiving the certified results, making a negative result at such a stage – for example one which indicates bacterial spoilage or mercury levels that are too high – a very unpopular one!

Her job has acutely influenced her life style. "I start looking at labels the moment I enter a store. I am very conscious of fat and cholesterol content, and because I am currently anaemic, I search for food products with high iron content," she explains.

"Balancing my work and my private life is a challenge – at the lab we have to deal with seasonality issues and sometimes receive large batches of food samples that have to be completed in a very short period," she says. Socialising is the first thing to fall by the wayside in hectic times, she says. Fortunately for Yoliswa, her family members are only too glad to help look after her son, Lihle (10).

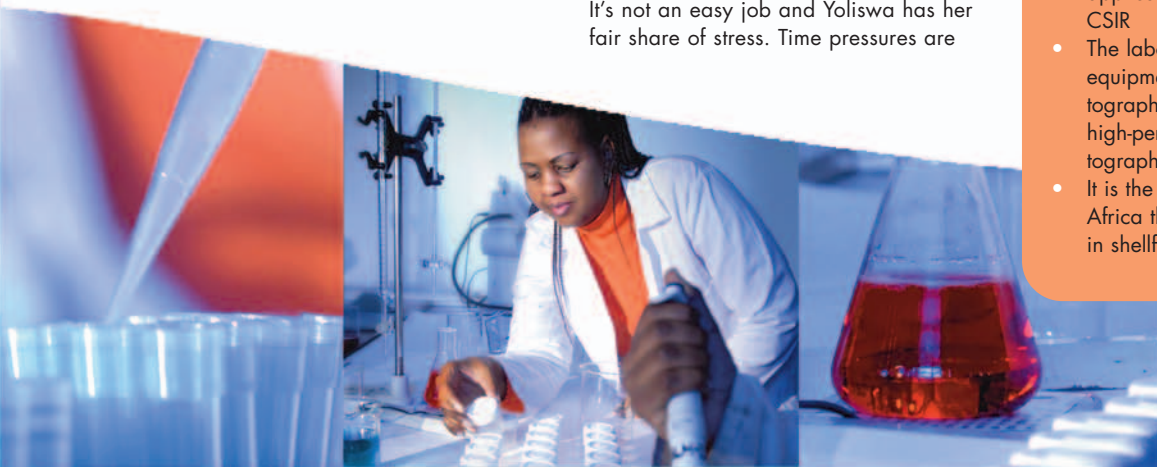
– Alida Britz

## ANALYTICAL CHEMISTRY

Analytical chemistry is the analysis of material samples to gain an understanding of their chemical composition and structure. It incorporates standardised experimental methods in chemistry.

## ABOUT THE CSIR CHEMICAL ANALYTICAL LABORATORY

- The laboratory resorts under CSIR Knowledge Services, which has been created as a vehicle to manage the routine and recurring application of knowledge in the CSIR
- The laboratory uses state-of-the-art equipment based on gas chromatography, mass spectrometry, high-performance liquid chromatography and atomic absorption
- It is the only laboratory in South Africa that can test for biotoxins in shellfish.



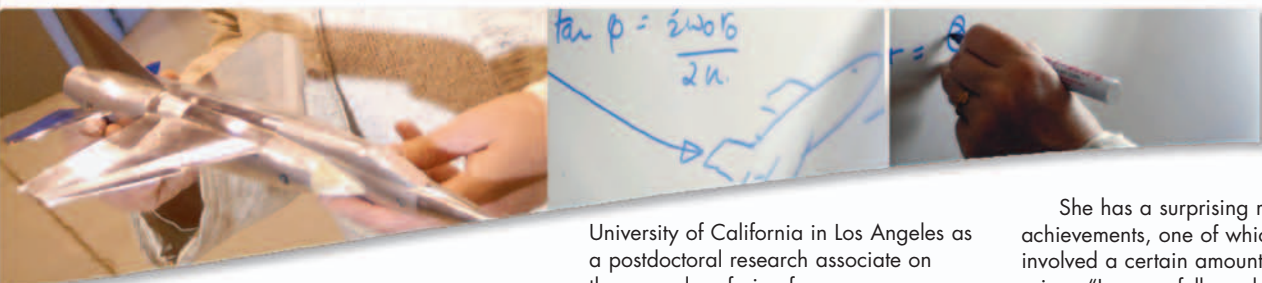
Iggle Gledhill

## Exploring the limits through physics



Dr Igle Gledhill, Fellow at CSIR Defence, Peace, Safety and Security, opens the conversation by pointing out, "Did you know that Igle is not my real name? Igle comes from I.Gledhill, a nickname given to me at school by my headmistress," she clarifies, but my parents named me Irvy."





Humour and a keen sense of the moment characterise Igle, who is a well-known and outspoken scientist at the CSIR. She is a member of the Strategic Research Panel involved in the Thematic Programme, the Young Researcher Establishment Fund and research development initiatives.

### A woman who sets her sights high

Igle's involvement and influence in the physics community extends nationally. She is President of the South African Association for Theoretical and Applied Mechanics; Chair of the South African National Committee for the International Union of Theoretical and Applied Mechanics and a member of the South African Institute of Physics Implementation Panel for "Shaping the future of physics in South Africa". She is also a member of the working group for Women in Physics in South Africa and a member of the Academy of Science of South Africa.

In 2005, she was part of an international panel that reviewed the physics community during a two-week lightning stint. She has participated in a review for the CSIR National Laser Centre of its Rental Pool Programme, which is supported by the National Research Foundation.

Igle has a BSc (Hons) in physics (with distinction) from Rhodes University and a PhD in plasma physics from the University of Natal (Durban). Her international collaboration with the Swedish Defence Research Institute on agile aircraft has led to a predictive method for dynamics during high-speed manoeuvres. She explains, "In essence, we have to discover what the aerodynamic effects of these manoeuvres are. Facilities such as wind tunnels can provide useful data, but we are extending the techniques to the extreme conditions that are now being encountered." This work was the topic of an international joint research paper published in 2003. The method is now being implemented for testing and application.

### Why physics?

Although Igle was initially interested in life sciences, she felt physical sciences would give her a good grounding to learn about life sciences. "So I went ahead and did a BSc with physics, chemistry and applied mathematics at Rhodes." She adds as a rueful aside, "I bitterly regretted doing applied mathematics III during a particularly challenging second exam paper."

During the 1980s, Igle worked at the

University of California in Los Angeles as a postdoctoral research associate on thermonuclear fusion for power generation. "I modelled plasma behaviour – plasmas are gases at the temperature of the stars," she tells, demonstrating her knack for making the complexity of her work comprehensible to non-physicists. "Our work was directed towards a mirror machine, which uses a magnetic field shaped like a Christmas cracker."

She then became a postdoctoral research associate at Stanford University and worked on space shuttle physics and galactic simulation. "We looked at the simulation of experiments in the space shuttle," she recounts. "At that stage, I was working on a NASA computer with 16 384 processors. The first parallel processing computer at the CSIR – now standing outside my office – has 53 processors!"

### Igle at work

Igle returned to work at the CSIR's National Institute for Aeronautics and Space Technology (NIAST). She focused on cellular automata – small complex systems that show organised behaviour – to gain insight into complex systems. ("No one should have to repeat 'cellular automata' twice in one sentence," she quips, when asked to repeat that particular polysyllabic combination.) Other aspects of her work included the simulation of methane and dust explosions in coal mines, and traffic simulations.

"I now have an irresistible challenge to use molecular dynamics to combat disease in South Africa," she says. She has joined a biotechnology team with the CSIR's Dr Colin Kenyon and the University of Pretoria's Professor Fourie Joubert as a computational physicist, and hopes to be able to continue this work in the future.

Her areas of specialisation are at the forefront of R&D: implications of the theory of accelerating objects, including airships and submarines, and non-linear optics, where she hopes to contribute in future. She is looking forward to utilising the benefits of the CSIR's high-performance computer, C4, in the near future.

What makes Igle's work worthwhile? Why is it important? "My work has to do with safety of aircraft when releasing stores," she explains. "This is undeniably important to those tasked to ensure the safety and security of our country."

"I love to see the benefits of working with young people," she continues. "They are so vibrant and active."

She has a surprising range of personal achievements, one of which must have involved a certain amount of grease and grime. "I successfully replaced a fuel pump on a 1975 5.7l Ford Camaro – it took me 10 hours." On a more serious note, she regards her participation in the 2001 Executive National Security Programme as a formative experience, when she worked with members of the SANDF on a national strategy. This programme is offered by the South African National Defence College for officers earmarked for promotion to high-ranking positions.

### Her formative years

She absorbs influences all around her. As a young child, these came from her parents: her mother was a botanist and her father, Professor Jack Gledhill, was head of the Physics Department at Rhodes. "I sometimes went on visits with him to famous laboratories, such as the Rutherford Labs," she recalls. "This was where I saw the excitement of research in action, although I could not grasp at the time why a blip on a graph was important."

From early on, she assumed that science would be the direction of her career.

She admires Richard Feynman as "an unfettered thinker", as well as Chuck Yeager, the first man to break the speed of sound in a jet.

### The role of physics in the CSIR's future

"I would like to contribute to building a stimulating environment and see the CSIR fitting into the jigsaw of national innovation," Igle says. "I will continue to do exciting work with useful applications, and encourage people by providing avenues to intellectual challenge and the opportunity to think." Her participation in cascade mentorship has resulted in a grouping that meets occasionally, comprising an external participant, Professor Beric Skews of the University of the Witwatersrand, as well as CSIR colleagues Dr Motodi Maserumule (head of Aeronautic Systems), Kaven Naidoo, Conrad Mahlase and Jeff Baloyi. She has also taken on a mentorship role within CSIR Defence, Peace, Safety and Security.

Igle's advice to women starting out in this field is straight yet encouraging, "Don't compromise your ideas. You will need imagination, analytical thinking skills and adaptability when confronted with difficult conditions." She stresses the importance of finding an identity in the workplace.

"I believe in equity for all people and exploring the interesting side of diversity."

– Biffy van Rooyen

# Persistence in chemistry pays off

**Moira Bode**



There are no half measures when Moira Bode takes on a challenge. It's little wonder she describes herself as logical and persistent. Up until a few minutes ago she was wearing her green lab coat designed to protect her clothing and skin from harmful chemical spillages. Her safety goggles lie discarded, but not too far away on the desk as she prepares herself for the interview. She highlights the importance of dressing for safety, especially when working in a chemical laboratory.



## Medicinal chemistry to address diseases

Moira is a synthetic organic chemist based at CSIR Biosciences in Modderfontein, leading the HIV/Aids research team.

"We are involved in a kind of medicinal chemistry relating to the areas of HIV, malaria and tuberculosis," she explains, "centred on the creation of complex molecules. You first identify a target molecule and then design a synthesis – you have to find the best way of making the complex molecule using simple starting materials. Many steps are usually needed to get to the desired compound, and you have to find the best way of tackling each step."

Scientists often endure the fickle nature of chemistry. "Chemistry is pretty unpredictable. There is a lot of trial and error involved, so one requires persistence," says Moira with a firm voice.

## Developing generic drugs to treat HIV/Aids

Her current research requires that persistence. Her group is focusing on exploring ways of producing generics of existing antiretroviral compounds such as stavudine and zidovudine (AZT). Moira reckons that if cheaper antiretrovirals could be made, more people could be treated with the government funding available. These drugs are in huge demand in South Africa and economies of scale come into play in their production. "We are also looking at the design of new protease inhibitors. It is a product attracting national interest," she adds.

The work on generics is undertaken in collaboration with the University of Cape Town for Arvir, a company that the CSIR has formed jointly with Lifelab, one of three Biotechnology Regional Innovation Centres along South Africa's east coast.

Moira plays a leading role as technical project leader of the highly active antiretroviral therapy (HAART)-Arvir project.

## What about impact?

She ponders awhile on the question of the impact of her work on society before volunteering a brief response. Moira is working on the synthesis of a natural product, but politely avoids detailed discussion as the information is shared intellectual property. "It's difficult to say whether something will work or not, but one has to hope it will have a successful and positive outcome," she adds.

## Early days

It was at Kaffarian Girls' High School in the Eastern Cape that Moira developed an affinity for science. "I have always been interested in science. Science and maths were my favourite subjects at high school," says Moira who matriculated with an A-aggregate, proof of her ambition to excel.

Later she attended Rhodes University in Grahamstown in the late 1980s, where she obtained her BSc and Honours degrees with distinction. In 1994, she was conferred a Doctorate in organic chemistry by the same institution. She has eight academic awards to her name, and has had her research published extensively.

Moira's career has taken her to the organic chemistry and catalysis laboratory in Delft, the Netherlands, and to the Division of Toxicology at the Onderstepoort Veterinary Institute where she held several management positions. She also lectured in the Department of Chemistry at the University of South Africa before joining the CSIR in 2003.

## What sparked her interest in this field of research?

"The thing about organic chemistry is that you've got something tangible. You make new compounds that have never been made before," she explains with passion.

But no success comes without a certain amount of failure. "Science is uncompromising. If something doesn't work, it's a challenge to find the solution. It's a yes-or-no science. You either can or can't," she says.

## Personal best

Besides following her ambitions, Moira rates obtaining her private pilot's licence at the age of 20 and a three-month research trip to Antarctica as two of her greatest achievements. "I wanted to become a commercial pilot when I was growing up, but I thought flying back and forth might become boring over time," she says, adding that frequent trips as a child in a family friend's light aircraft stimulated her interest.

And being someone who was born and raised in the rural former Transkei, Moira enjoyed the vast expanse of Antarctica during an expedition undertaken 16 years ago.

"Antarctica was one of my most amazing experiences – the expanse, whiteness; the solitude and the penguins... That trip is something I will never forget. I like places where I can get away from people," adds Moira, who now lives in Johannesburg.

"My parents always encouraged me. I'm grateful for that." Her mentors have included past supervisors and lecturers. Interaction with her CSIR colleagues also helps her in achieving her vision, which is simply "to make a difference in people's lives".

And when she is not experimenting with science, Moira sings in the opera chorus of the Black Tie Ensemble, and is a wife and mother to her young son and daughter. "Time management is difficult, but I try to have a balance in my life," she says.

## Science – the great equaliser

Her parting words of advice to women and people interested in a career in science is: "You must really love science because the only thing that you get out of it is the enjoyment of science. It can be rewarding when you achieve something that has never been done before. Science is a great equaliser in some sense. When you achieve something, it doesn't matter whether you're a woman or a man; you have the chance to prove yourself," says Moira before donning her lab coat again.

– Asha Speckman





**Mwanisa Saidi** Involving communities in their future



South Africa is facing growing political and social pressures around basic infrastructure provision and service delivery. One of government's key strategies to address these demands is to widen public participation in decision-making around resource allocation. The work of Mwanisa Saidi, a young research architect at CSIR Built Environment, is making an important contribution towards ensuring that communities are actively involved in planning and managing their own development.





### Developing tools for social infrastructure

Mwansa is involved in applied research in the delivery, maintenance and management of social infrastructure with community participation. Her expertise relates particularly to the impact of infrastructure delivery on community development, focusing on socio-economic aspects in poor areas.

"At the moment, my work is aimed at developing tools and concepts to reduce the negative impact of the built environment and optimise human and social interaction with the built environment and its processes," Mwansa explains. This involves researching the interfaces between people and the built environment, focusing on both performance optimisation issues, for example, in the workplace, and in learning and healing environments, as well as how the built environment responds to issues such as community participation, social cohesion and other anthropological concerns.

### Integrating people and the environment

Mwansa's interest in the interface between people and the built environment dates back to 2003, when she was completing her MSc in project management at the University of Pretoria. She became involved in a project funded by the UK Department for International Development (DFID) to study community asset management in Africa. When the project was subcontracted to the CSIR, Mwansa was offered a contract appointment at the organisation. Six months later, the CSIR offered her a permanent position. "At the time, my main priorities were to complete my studies and raise my two young children – I wasn't really looking for a job," she recalls. However, she accepted the offer and became the principal researcher on the DFID project. "My interest in commu-

nity-based planning and the impact of infrastructure on community development grew from there."

### Empowering communities

She subsequently played a leading role in the development of the community asset mapping and mobilisation (CAMM) methodology, an asset-based process developed to ensure that the construction of community assets could be integrated with local community development to enable sustainability through meaningful community participation and empowerment. "The CAMM approach facilitates community involvement, participation and capacity-building in development interventions, with the ultimate aim of empowering communities to manage assets after delivery," she explains. Recognition for her work in this field includes a Young Professional Award from her CSIR operating unit in 2004.

### A successful portfolio of work

Mwansa and Geci Karuri, previously with the CSIR and now a chief research manager at the Human Sciences Research Council, presented a paper on a CAMM case study at the Planning Africa 2006 Conference in Cape Town earlier this year. The Imperani Tourism and Training Centre (ITTC) in Ficksburg in the Free State entailed the rehabilitation of an abandoned set of historical sandstone buildings into a community development centre, using labour-intensive infrastructure development technologies.

"With the application of the CAMM methodology, the project facility was planned as a centre that could stimulate broad capacity-building and empowerment, job creation and local social and economic development," Mwansa explains. "It helped the community identify, mobilise and control their own assets." A Section 21 company has been established, with a community governing structure in the form of a board of directors taking responsibility for the management and governance of the centre.

Key successes of the Ficksburg-based ITTC project include community buy-in and participation; the emergence of community champions; local partnerships and stakeholder involvement; cross-sectional asset mapping; and the linkage of the CAMM process to the local municipality's integrated development planning process.

Another paper by Mwansa and Gecci won the award for best paper at the 2005 World Sustainable Building Conference in Tokyo. An examination of the role of building contractors in enabling community empowerment and asset

management, the study was based on the CSIR's ongoing exploration of how to incorporate asset-based approaches in the development of the built environment.

### Lessons from role models

Mwansa's background partly explains her interest in the empowerment of disadvantaged communities. Born and raised in the Copperbelt mining area of Zambia, she had to shoulder individual responsibility from an early age. "My mother was incredibly hard-working, focused and disciplined," she recalls. "She taught me the importance of getting an education and always emphasised that this was not a responsibility you could abdicate."

From a professional point of view, Mwansa has been inspired by Geci. "She has a very structured approach to her work and her research is testimony to this." Mwansa also mentions fellow CSIR researchers Karina Landman and Chrisna du Plessis as role models. "They both have such passion for their respective fields and are very focused.

Mwansa credits her husband, a senior lecturer in landscape architecture at the University of Cape Town, as the most stabilising influence in her life. "He is wise beyond his years, a very understanding and supportive husband who shares the responsibility of raising our children. I rely on his guidance and advice, and his ability to slow me down when I'm moving too fast," she laughs.

### A PhD on the cards

Discussing her plans for the future, Mwansa mentions that she is in the process of registering for a PhD at the University of Stellenbosch. "I want to focus some of my efforts on studying the integration, at facility level, of Western health facilities with traditional practices," she says. "I will also be continuing my work on the development of a national poverty alleviation system, and the development of a systems management model with the emphasis on social issues in the built environment."

Mwansa's message to women students considering careers in science, engineering or technology is succinct: "Know yourself, set clear goals and don't allow yourself to be intimidated – have confidence in your abilities". She cites the example of millions of South African women from rural areas who work in cities far away from home. "These women have developed a highly successful methodology to earn an income while at the same time managing a household in absentia. We should all be inspired by their ability to juggle so many responsibilities."

– Deidre Lotter

Rachel Chikwamba

## Biotechnology at work for better crops



Nurturing the talent of emerging young scientists is one of the foremost reasons that drives Dr Rachel Chikwamba to perform as she does. She is among the most respected scientists at CSIR Biosciences, where she is research group leader in plant biology.



### Leading by example

"That's the best thing about being a scientist – working with young scientists," are Rachel's first words after ushering out her understudies. She portrays the image of a benevolent scientist whose belief in human capital development sees her nurturing the personal growth of individuals besides her own two sons.

"I enjoy helping young scientists to be the best they can be," she says. "Some are natural scientists, but they need to be nurtured so that they can eventually replace the likes of us," says Rachel, who draws inspiration from her own mentors – her mother, supervisors and the lecturers at various tertiary institutions she has attended. "I inherited a great deal of drive from my late mom. She accomplished far more than her education allowed," she says.

### Focusing on genetics and plant breeding

Rachel's academic background is in genetics and plant breeding, focusing on enhancing the cultural value of traditional crops. She is researching the production of molecules with medicinal value; sub-unit vaccines for the control of infectious diseases, for the creation of antibodies against HIV, and microbicidal molecules used in gels to prevent transmission of HIV/Aids.

Her research also seeks to provide different culture systems for indigenous plants and increase the active ingredients of their medicinal value. However, it is in crop improvement where Rachel finds her niche. She is currently involved in a Bill and Melinda Gates Foundation-funded research project aimed at improving the nutritional value of the African staple food, sorghum, harnessing biotechnology to create a "super sorghum" that will reduce micronutrient malnutrition.

"Making an impact will involve much work. A great deal of potential is unfolding. We are looking to develop the potential of sorghum – from nutritional value to other aspects of crop productivity. We are involved in many projects that target the socially important goal of improving livelihoods of rural people. We also want to be

able to manufacture vaccines and other pharmaceuticals to treat infectious diseases," says the scientist who obtained her MSc and PhD from the University of Queensland, Australia and Iowa State, USA, respectively. "My interest has always been in something to take back to the rural agricultural community from which I come."

### The inspiration of mentors

One of her earliest mentors while reading towards her honours degree at the University of Zimbabwe, a certain Professor Robertson, inspired her move towards biotechnology. "He talked about the future through biotechnology. For the most part, everyone considered him eccentric. He said that as long as we have the will and motivation we can achieve anything. At that time, people didn't really think biotechnology had a place in developing countries," she adds.

Another of her mentors, Professor Kan Wang, hails from China. "She came from a humble background making pencils in a lead factory and hardly had time to study. She taught me to believe in myself," recalls Rachel. "It was encouraging to be allowed an opportunity to be creative and to challenge her thoughts and wisdom. She allowed me to grow by not constantly looking over my shoulder." Today Kan is a professor and director of the Centre for Plant Transformation at Iowa University in the USA.

Professor Charles Arntzen has inspired Rachel to cultivate modesty. "He's the kind of person who measures his success by the achievements of people he has mentored," she adds.

### Achievements of note

Professionally, she has achieved much in her career. Rachel has been presented with awards for research excellence and she has been granted research scholarships, namely as a fellow of the Rockefeller Foundation between 1997 and 2002 towards her doctoral studies. In 2004, she was made Honorary Research Fellow of St George's Hospital Medical Centre in the UK. This year she was appointed as a CSIR Biosciences Fellow.

Her research has also been widely published in journals and presented at national and international conferences, while succeeding in attracting grant funding for projects and filing a patent (starch targeting and encapsulation) in 2002.

Rachel also regards opportunities to work in advanced laboratories abroad as an achievement. "I found myself to be the only black scientist in a lab. I thought people would be unkind. They were not, but you always have to pressurise yourself to go the extra mile. When surrounded by people with ambition, it spurs you on to be competitive. Peer pressure is good if it makes you achieve."

### Finding that balance

Yet she regards juggling family life and a demanding career as her most significant achievement to date. "I produced a high quality dissertation while nursing a baby. That was one of my initial challenges," says Rachel who had her first child at a young age. "This is usually a hurdle, but I was encouraged to continue studying. I have been married for 19 years, have two children and I am very happy." Today her eldest son is 17 and completing matric, while her youngest is five.

"I have to attend meetings and conferences and still go home to help the children with their homework. I struggle to cope, but I've learnt one thing: set a schedule and stick to it. I have meetings with my team on certain days. They always come first. I'm there when I'm supposed to be," says Rachel, who also lectures at the University of Pretoria.

"Follow your dream," is the advice she offers. "Being a woman and having a family are not obstacles. Grab all the opportunities, believe in yourself and never sacrifice the things that are good about being a woman. Do your hair, your face, have your children and enjoy them and deliver on your commitments."

"I have always wanted to be a scientist. I remember wanting to be a nurse, a medical doctor or a science teacher," she says. And her dream for her career future? "I see myself as an old scientist who looks back and sees many successful young people continuing my mentorship and teaching," says the woman who describes herself as "driven, inspired and hoping to be inspirational".

– Asha Speckman





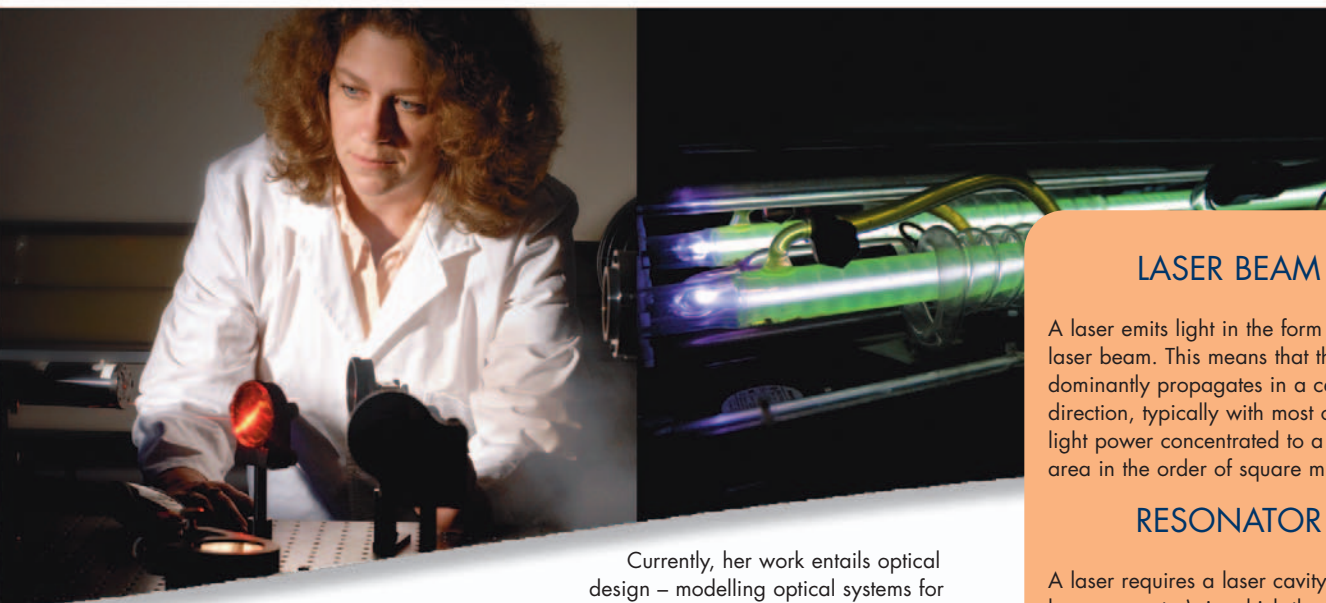
# Liesl Burger

## Focusing the power of light



Liesl Burger uses the power of lasers daily in advanced research for industrial and military applications. CSIR laser research has also been extended to the use of lasers in the health domain and in combating air pollution.





### New research focus for optical engineering

"I'm looking forward to the future with a great deal of optimism," says Liesl, an optical engineer at the CSIR National Laser Centre. Referring to the challenges presented by the CSIR's Beyond 60 process with its renewed focus on research, she says, "I started my career with research into tuneable carbon dioxide lasers after which the focus turned to commercial applications. Now I am quite pleased to once again be channelling my energies into the challenges a research focus presents."

The industrial applications of lasers are typically for cutting machines with which to cut non-metals such as plastics, cardboard and even fabric. In the military field, lasers are useful in missile counter-measures, laser range finders and target designation. Other applications that are being investigated with research partners are how laser technology can improve wound healing in diabetic patients and kill cancerous cells. The CSIR is also looking at the use of Differential Absorption Lidar (DIAL) to assist in combating atmospheric pollution.

### The lure of lasers

Liesl fell in love with physics and applied mathematics at school, and it seemed logical for her to pursue a BSc degree at the University of the Witwatersrand. As she was a CSIR bursar, she was afforded the opportunity to work at the organisation during vacations and upon completion of her studies. "I started off working in the laser section of the unit then called Productiontek," Liesl explains. "Lasers interested me and I decided to stay," she adds. The laser section later became the CSIR National Laser Centre (NLC).

Currently, her work entails optical design – modelling optical systems for commercial and military applications. She uses various software packages such as Zemax and GLAD to model the path of light through components such as lenses, laser resonators and reflections off mirrors.

Zemax is a ray-tracing package, which can be used to model any lens system, although the CSIR's focus is predominantly on lenses used in laser applications. Other applications may include the modelling of photographic lenses, scanning systems, numerically-controlled computer (NCC) equipment or any other optical system. The GLAD system, on the other hand, models the wave nature of light, and is more useful for modelling laser systems because it is physically more accurate. "There is an overlap in functionality, but typically I use the one for lenses and the other for laser resonators," Liesl explains. "Our work includes assisting clients in any of the many laser application domains in producing or optimising a laser for their specific application. What we ultimately offer them is detailed information on the beam they can expect, as well as the tool to optimise it."

Liesl says clients specify the characteristics of the laser beam they require, for example, the size of the beam at some point, its energy, pulse length and divergence. A laser with associated optics can be designed to meet these requirements. "Simplified, you 'tell' the software what the initial beam looks like, and what its profile and intensity are. You 'inform' the software what the beam passes through (lenses, apertures, etc.) and propagate the light through these components. The software then models diffraction effects and keeps track of the energy distribution. This software is a really powerful tool," she says, "but the skill lies in developing a model that accurately predicts real-world behaviour."

### LASER BEAM

A laser emits light in the form of a laser beam. This means that the light dominantly propagates in a certain direction, typically with most of the light power concentrated to a small area in the order of square millimetres

### RESONATOR

A laser requires a laser cavity (or laser resonator), in which the laser radiation can circulate and pass a gain medium that compensates the cavity losses

### PHYSICAL OPTICS

The branch of optics that treats light propagation as a wave phenomenon rather than a ray phenomenon, as in geometric optics

Liesl's work requires an understanding of computer programming and physics. She undertakes work mostly for external clients, but also advises her colleagues who are conducting research into an array of laser-related projects. Some of her previous projects included building laser-cutting machines and other laser systems, for example, laser systems used by architects to almost effortlessly construct a model from a CAD drawing.

### On a personal note

Professional achievements are not about prestigious awards for her, but rather about experimentally verifying the systems that she has modelled. At the top of her personal achievements list is raising two bright children. She reads many popular science publications and says that author Carl Sagan inspires her. Her high school maths and science teachers were her role models while growing up. Liesl describes herself as being an "inquisitive, rational and methodical person who listens to a lot of alternative rock music." She recently attended a rock concert in London, and collects bootleg recordings. She cites hard work and believing in oneself as important traits, and it is these attributes that she encourages young women out there to aspire to.

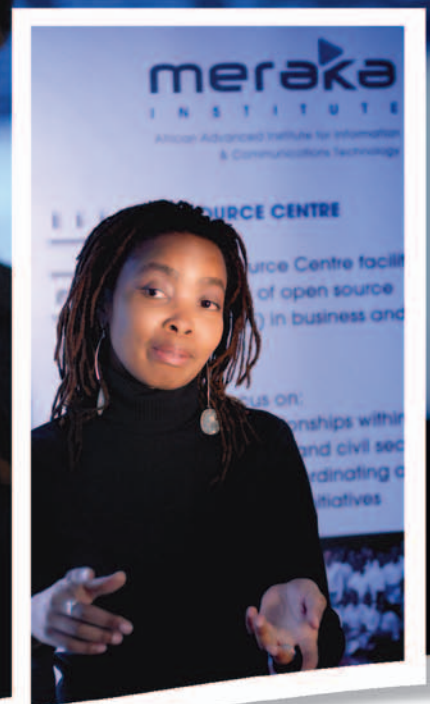
– *Tilhoji Mokhema*

# Pumla Gqola

## Open debate on the politics of technology

Dr Pumla Dineo Gqola has just recently joined the Meraka Institute Open Source Centre, a national research centre managed by the CSIR.

How did a highly qualified academic with two Masters degrees and a DPhil in post-colonial studies come to join the institute that operates in the realm of information and communications technology (ICT)?



### GEEK FREEDOM LEAGUE

A movement started by the Go Open campaign to encourage the use and sharing of free/libre and open source software

### MESH NETWORKING

A very reliable and inexpensive way of routing information (data, voice, instructions, etc.) through two or more paths that allow for the flow of information even when parts are defective by re-routing the data through other paths within the mesh





### Challenging current thinking

Pumla's decision to join the organisation was made once her role in the free/libre and open source software (FLOSS) movement became clear to her. As focus area leader: OpenSpeak (which has to date been concerned with advocacy for FLOSS), Pumla is interested in the sociality of technology. "We need to constantly challenge the assumption that technology is neutral, as this masks blind spots," she says. "All technological choices have consequences, either negative or positive."

Feisty and outspoken, she embraces her involvement in the larger development discourse where technology is part of a solution. "My role is to address transformation and interrogate the politics of technology," she points out. "There is no automatic transformation, no straightforward method of employing ICT for transformation. A healthy, critical attitude is essential in determining the best path and tools to achieve the kinds of changes we want for the future."

Her interest lies in understanding how knowledge travels and the use and abuse of power through knowledge. Her earlier work focused on gender, sexuality, race and class as the context to explore how power dynamics put up and pull down structures and paradigms in society.

### Finding connections between society and technology

Pumla's decision to join the Meraka Institute has meant a big leap from humanities and social sciences to an environment where scientific and technological innovation and research are the means to an end. "I plan to develop a research programme for OpenSpeak," she explains. "This is a change in direction from its earlier role as an awareness-raising campaign with a strong marketing and publicity drive. A research focus will seek out connections between society and technology."

Her research agenda is clear. "We will continue to work with our current partners, while expanding these networks," she confirms. "We need to consider the implications of our work to policy formula-

tion, and map successes and failures of FLOSS." She also hopes to contribute to an open approach to research.

Pumla believes in constructive debate and is never at a loss for words, "We must continue our conversations, internally and externally. Without conversations, we simply cannot move forward."

Unwavering on her stance regarding the position of technology, Pumla is quick to see and exploit the advantages of accessibility of and reporting through open technology. She cites the example of the Truth and Reconciliation Conference held in April 2006 to commemorate the 10th anniversary, where its implications and impact were examined. "Through open source, we have the tools to access and use these archives and reports, and yet they remain locked in expensive proprietary platforms."

At another conference on inclusive cities held by the Woodrow Wilson Institute for Scholars in Washington, DC in May 2006, her presentation highlighted some of the ways in which humanities and social scientific tools can work in OpenSpeak. "By exploring the sociality of the FLOSS movement within the urban space, we have the tools and potential to understand the processes used to access or contest power."

### What will OpenSpeak achieve?

Pumla believes in encouraging the conversation between social and economic aspects and technology. "Look at cell phones and how this phenomenon has had an impact on the social and economic landscapes," she points out, adding that society has a short memory regarding technological innovations. "Can anyone remember a world without TV or cell phones? Both have altered our lives as South Africans radically in the past 30 years." Similarly, other technology and infrastructural resources should be examined for both current and future impact. Such knowledge can obviate haphazard use and ineffective application.

The Meraka Institute Soweto office, launched in May 2006, has become a hub for the grouping of technologies and activities of communities and individuals.

Mesh networking, an enabling technology to achieve connectivity at low cost, is complemented by the presence of the Soweto Geeks, a group of young FLOSS enthusiasts. Into this mix comes the Kasi Open Source Society, enthusiasts working with FLOSS applications.

### Pumla the person

Although she has previously held senior posts at the University of the Free State and the Human Sciences Research Council, Pumla identifies her greatest achievement to date as being invited to Extraordinary Associate Professorship in humanities at the University of the Western Cape. "It felt like coming home, given its similarities to Fort Hare," she muses. "I value this invitation for its implicit recognition, validation and affirmation of the type and quality of my work."

Growing up on the campus at Fort Hare during the 1970s and 1980s was a seminal influence in her life. Her father was an organic chemist and lecturer at the university, while her mother was an orthopaedic nurse at the town's hospital. Tolerance and understanding characterised her home environment, while the climate on campus was alive with ideas and action. "It was a political campus, with activists among students and staff," she remembers. "The people I knew were academics; I was surrounded by black intellectuals, so that was my norm. It was inevitable that I chose to become an academic since that was the bulk of what I saw in the adults around me. Fort Hare also shaped my assumptions about my own capacity."

Those formative years helped to create an independent and clear-thinking woman, with a clear plan ahead for her own future, "You see why I have no patience with neutrality or neat categorisation?" Pumla says.

### A view to the future

Within the next five years, Pumla envisages that OpenSpeak will be recognised as a research area, well on its way to becoming a centre of excellence. In addition to a strong research output, she will continue to nurture and cultivate good partnerships. "And we must also be flexible enough to change direction, if needed," she adds as a qualification.

Her advice to women starting out in a career is, "Be driven and stubborn," she says. "Believe in what you want to achieve and be determined to do it." She emphasises the value of support networks to make conversations possible with other women: a support base outside the working context is essential. Her final words, "Make time for what you want and be honest with yourself: you will know what you need."

— Biffy van Rooyen

# Modelling complex behaviour

# Isobel McDougall



Dr Isobel McDougall opted for a domain acknowledged to be an incredibly complicated one, where only a handful of people are regarded as experts.



## A woman who likes a challenge

In computational modelling, aspects such as finite element analysis, primary processes, computational fluid dynamics, non-linear materials and loadings and temperature-dependent problems are commonplace. Complex as these concepts are, Isobel describes her work in the world of heavy engineering and process industries as "exciting and challenging".

Having just completed a PhD in civil engineering with a thesis on "Computational Modelling of Søderberg Electrodes", Isobel had to tackle her degree long-distance on a part-time basis at the University of Wales in Swansea. Very few tertiary institutions are equipped for specialisation in this field.

As research group leader in primary processes at CSIR Materials Science and Manufacturing, Isobel's groundbreaking work focuses on Søderberg electrodes. These electrodes are used in submerged-arc furnaces, such as those employed in the smelting of ferroalloys and ferrosilicon.

Large-scale experimental work on operating furnaces is difficult to perform, for both technical and economic reasons. The modelling of the electrode using numerical techniques is an attractive option, as it allows for numerical experimentation without the risks associated with physical experimentation. The objective of this study is to generate three-dimensional finite element models of the Søderberg electrode. This includes the complex behaviour associated with the baking of the electrode paste and vanishing of the steel-casing during operation, as well as the coupled electromagnetic fluid flow, as well as the thermal and mechanical aspects of the furnace environment in which the electrode is operated.

In her studies, Isobel managed to demonstrate a method for generating a comprehensive electromagnetic thermal-stress model of the Søderberg electrode using commercial software. The results demonstrate asymmetries in the tempera-

tures and current densities due to the proximity of the electrodes to one another, effects that are known to furnace operators.

"The electrode modelling project provided the opportunity to move from fairly ordinary applications of the commercial software to testing the limits of what the software can do. Creating a successful finite element model of the Søderberg electrode is probably my greatest professional achievement to date," she says.

## Multi-physical modelling leads to novel applications

Isobel has always found computational modelling interesting. Her multiphysics specialisation arose from a client's requirement and has grown into a number of projects.

Her research currently involves the modelling of magneto hydro dynamics effects in alternating current furnaces, and refining the modelling of the thermal effects due to the applied electrical currents. In addition, novel material applications are being studied and evaluated for applications in various parts of reduction vessels.

In the multi-physical modelling of systems, Isobel performs the electromagnetic calculations, as well as the thermal and stress or displacement analyses.

## Versatility in all walks of life

Male-dominated as this field may sound, Isobel laughs at the notion of working in a man's world. "It does not bother me at all! If someone has a problem with it, so be it. I don't."

Then her eyes twinkle, "My mother still thinks I should not be in this field, because it's too unconventional for a woman." But then, it was also her mother who ensured an unexpected flip side to this woman's character.

She remembers being regarded as somewhat "strange" when she was a pre-graduate. To top it all, she decided to do a welding course to brighten up one

holiday. A request to which her father and first mentor, and also an engineer, readily agreed. She describes her father as a man of great integrity who insists that things should be done properly. "I hope some of it rubbed off on me," she comments.

"I believe there should be beautiful things in life," she says "and it was my mother who taught me to make my first dress at the age of 11 or 12". Today Isobel is an accomplished seamstress and excels in patchwork, which she painstakingly does by hand.

Isobel is wife and mother to a husband and two teenagers, and lives on a small-holding in Midrand with a menagerie of three dogs, a cat and some fish. "Most of my time at home is spent being a mom – violin and piano tutor, personal coach, consultant in IT, maths, science, Afrikaans and English, cheerleader and taxi driver."

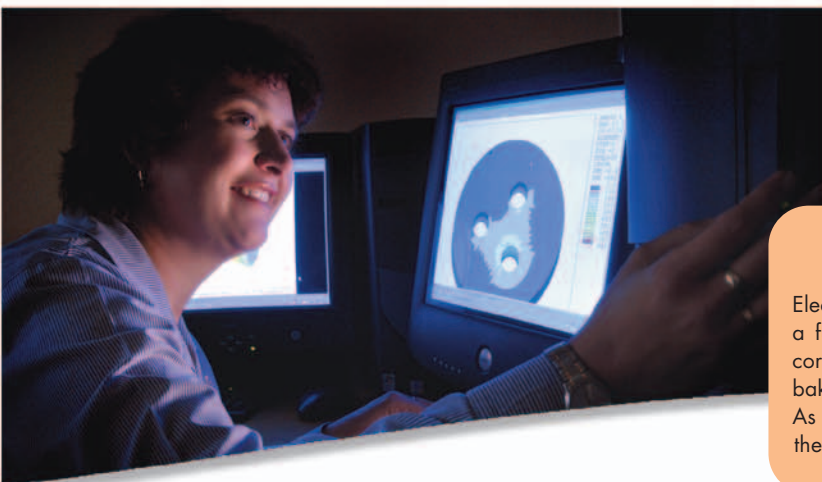
Her warm family persona is evident as she describes her husband Donald, who is also an engineer and mentor. "He is the love of my life, because he is so different to me, and he's not afraid of chasing rain-bows. He is much more adventurous than I am, and does things that I would be much too conservative to even consider. Life is much more interesting with him around," she says.

## Expecting the impossible

From yet another mentor, Dr Bruce Olmstead, her predecessor as research group leader, she learnt that nearly anything is possible if your vision of what might be done is big enough. "Bruce mentored me through my PhD. His habit of expecting the impossible inspired all the members of our research group to deliver amazing results," she says.

The next step at work is to create a single multiphysics model that includes all the important aspects of furnace behaviour. At least one software package professes that it can be done. "I would like to test this and I want to grow our research group into one of the world's significant players in this field."

Impossible? Not with Isobel McDougall – who found computational modelling a breeze. **- Patsy Scholtz**



## SØDERBERG ELECTRODE

Electrodes provide the path through which electricity passes into a furnace. The Søderberg electrode has a metal casing and a core of carbon paste. The casing contains the paste before it is baked and provides a path for the flow of current into the paste. As the carbon heats up, the paste bakes to form the electrode and the casing burns away.

# Valencia Jacobs

## Small science – big feat



**When it comes to science, she wants to be centre-stage – right where it happens.**

That is why Valencia Jacobs, researcher at CSIR Materials Science and Manufacturing, chose chemistry as her major. Often referred to as a central science, it incorporates and supports other sciences such as nanotechnology and physics.



### Unlimited challenges

Having chosen the "science of the small", Valencia finds herself in the exciting and diverse area of nanotechnology, which is pivotal for all future research.

Nanotechnology is the study and manipulation of tiny material structures with at least one dimension roughly between 1 and 100 nm. "Nano being derived from the Greek word 'nanos' meaning 'dwarf' or 'small', has become the buzzword in the science community," says Valencia, "and nanoscience offers unlimited challenges."

### Fibres of the future

Her research focuses on the niche area of electrospinning for generating nanofibres for surface modification of non-woven fibres, both natural and synthetic. These polymeric nanofibres are unique as they possess interesting properties, such as their extremely high surface-to-weight ratio when compared to other traditional fibre structures. The nanofibres are ultra-thin in size, in the range of one billionth of a metre and a thousand times thinner than a human hair. These fibres are thus ideal for a variety of applications such as biomedicine, filtration, protective clothing, cosmetics and others.

"With the textile industry in the country being challenged by foreign markets at the moment, this work is very relevant. It focuses on new niche products and explores new technologies and differentiated products, which can improve the performance of traditional textiles," she says excitedly.

With her current research, which is also the subject of a PhD, she wants to reach new heights and let these optimal aspirants for various applications contribute to the revival of the textile industry in South Africa.

### Strong women make strong role models

While Valencia is clearly serious about her work, she displays a zest for life which will inevitably translate into success.

The best aspect about her work is "spending time in her laboratory". She laughs with gusto as she explains that she enjoys going into the laboratory to do what is required of her. "That makes me tick," she says.

Valencia grew up in a very close and happy family where her mother and grandmother played key roles. She has only the highest regard for these strong and dedicated women who taught her the most prominent values in life.

Valencia remembers not being able to go to university after matric because of financial constraints, while all her friends could go. Explaining the situation to her, her grandmother told her not to lose her willpower to become a chemist. "If you are determined, and you wait patiently the opportunity will come." The young Valencia took this advice to heart and a year later she followed her dream at the University of Fort Hare. Once started, very little could stop her and she went from strength to strength.

Valencia believes that life is a process of development and that various people contribute towards mentoring an individual. She considers everyone who has added value to what she is today as a mentor. She has respect for people who encourage the good in others and make a difference in that way.

She says that science is a springboard for personal and societal development. "As the nation is maturing, women are afforded opportunities to show their courage and potential in various career avenues, and science is no exception. The pool of scientists is diminishing and women should start becoming inquisitive to learn and understand the applications of this important discipline."

### And what does she do for fun?

Valencia has a hectic schedule totally unrelated to work. But top of this list is definitely shopping. "That does it for me," she says. Shopping, even if it is only window-shopping, relaxes her and gets the blood flowing.

Valencia has loads of dreams for the future. Apart from completing her PhD, she has her sights set on developing her research skills and becoming a respected scientist in her field.

Judging by her track record, this woman with her infectious cheerful personality is going to make sure that she gets there.

– Patsy Scholtz

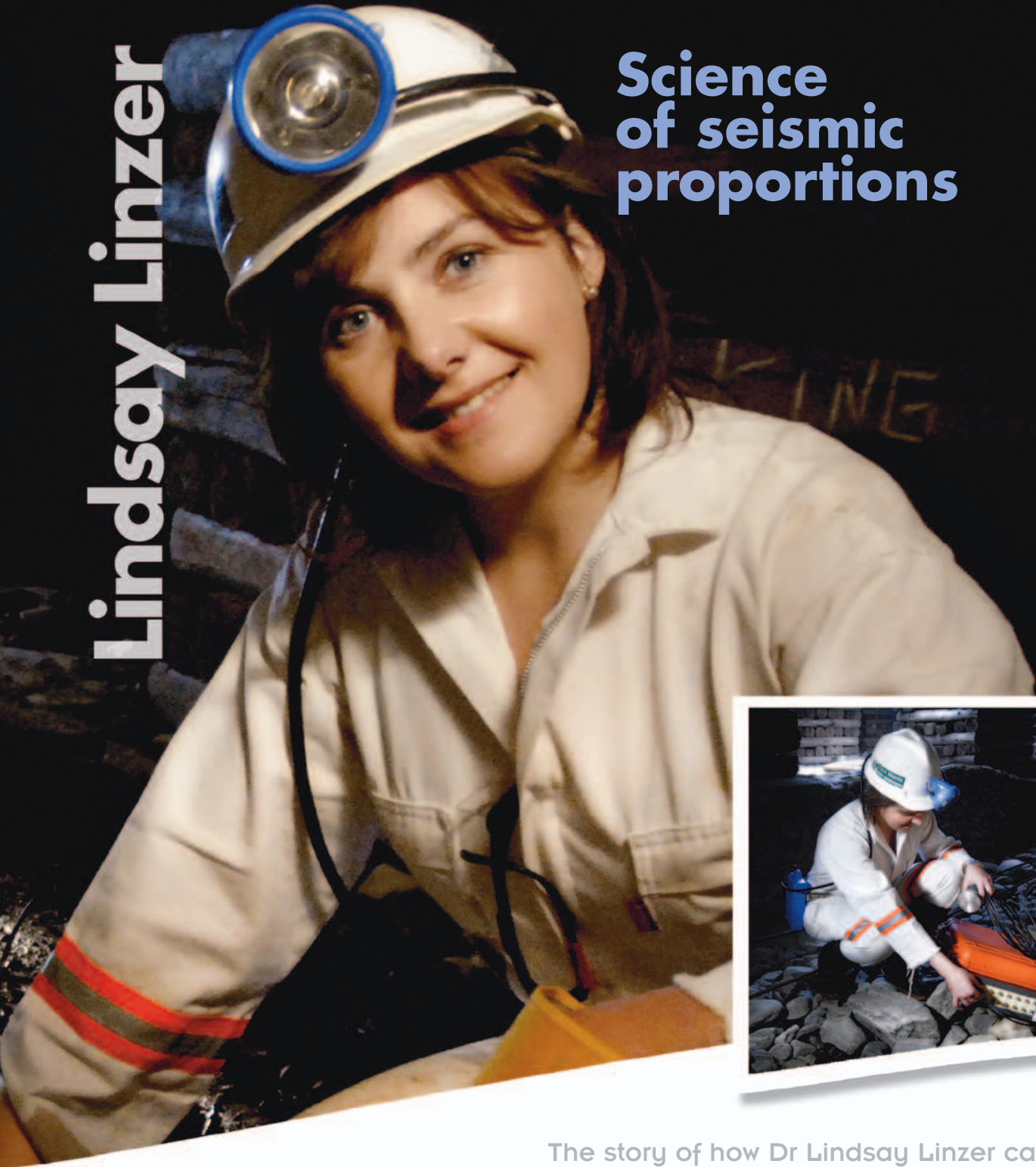
## ELECTROSPINNING

A technique in which high-voltage electrical fields are introduced to polymeric solutions (or melts in some other cases) to fabricate nanofibres.



Lindsay Linzer

## Science of seismic proportions



The story of how Dr Lindsay Linzer came to realise that life should not be taken for granted, and that each day should be cherished, is no fairy tale. Instead, it is an inspiring account of a woman so determined and focused on her love for science that she recovered from a serious back injury to get her flourishing career back on track. "Those months when I couldn't come to work, and lost a lot of ground with my projects, were the most despondent of my life," she says. "Fortunately, I was blessed with full recovery, and my life and career are now more fulfilling than ever before," she adds.



## MOMENT TENSOR

Convenient way of representing a seismic source by means of an equivalent force system.

## ROCKBURSTS

The instantaneous failure of rock causing a sudden violent expulsion of rock material at the surface of an excavation. It can be a serious hazard to people and equipment, and happens when a relatively large seismic event occurs close to the excavation.



### A seismologist of note

Lindsay joined the CSIR in July 1995 as a seismologist in the rock engineering programme. Her different roles over the years have always centered around establishing an expert understanding of seismic sources in the underground mining environment. This is important for engineering and safety. "Our research is focused on understanding how the rock fractures near excavations and pre-existing geological structures react to the change in stress field that is a direct result of mining activities," Lindsay says. "The earth models used in mining seismology are based on those developed for global seismology, and do not take into account the effects of the voids underground. Our research is focused on finding seismology models that are relevant to the South African reality. We want to change the misconception that mining and seismology aren't coupled," she adds.

According to Lindsay, current mining seismology models ignore the following facts:

- The earth is not homogeneous and the layering can result in diffraction, refraction and reflection of the raypaths
- The existence of voids (excavations) exposes free surfaces and can lead to amplification effects
- Stress fracturing occurs in the vicinity of the excavations, leading to slower velocities and coseismic slope convergence.

Lindsay's greatest contribution to this field was the development and design of a seismic moment tensor inversion toolbox, consisting of various software programs including:

- MTI Toolbox: a Delphi program that performs various types of moment tensor inversions (absolute, relative and hybrid methods)
- Synth-E-Seis: a Delphi program that calculates synthetic P and S-wave displacements for a given network and user-selected mechanisms
- Fault plane solution generator: a Delphi program that computes fault plane solutions from an input mechanism.

### Rocha Medal for PhD project

This research started off as a PhD project titled *A Relative Moment Tensor Inversion Technique applied to Seismicity Induced by Mining*. The software is being used by various research institutions around the globe including Sweden, Germany and the United States of America. It was also used extensively to calculate the source mechanisms of mining-induced seismicity in a number of settings, using seismograms recorded by MISTRAS (AE), PRISM and ISS systems, as well as for synthetic data generated using WAVE (a 3D finite difference program), for a number of CSIR projects. "The main advantage of the moment tensor inversion program is that it gives you an understanding of how rock fails underground," says Lindsay. "Better understanding can lead to better adaptations in how mining activities are executed, in the design of mine layouts, for instance."

Lindsay considers this programme as one the major achievements in her life. "It all started out as a Masters project, and then the examiners encouraged me to add one more chapter to it to obtain my PhD," she states. "That one chapter turned into four, and the focus shifted, resulting in my putting most of the MSc work into the appendix." Her thesis was awarded the Rocha Medal for the best PhD thesis in rock engineering internationally in 2003. "The Rocha Medal is a bronze medal that is awarded annually by the International Society for Rock Mechanics in memory of Manuel Rocha," she adds.

### Research grant for further study

Further to her Rocha medal, Lindsay was recently awarded a research grant of \$30 000 by the Schlumberger Foundation Faculty for the Future Programme for further study at the University of Pennsylvania. This faculty engages in strategic partnerships with the education sector, particularly in emerging economies, to encourage women in their pursuit of academic careers in science and technology. The research grant will cover tuition in advanced seismology and seismic exploration methods. It is envisaged that the training will increase the CSIR's skills

base and will enable Lindsay to lecture in exploration seismology at the University of the Witwatersrand, enhancing the link between the CSIR and academic institutions.

### A valuable addition to SAGA and IASPEI

Lindsay was recently voted President of the South African Geophysical Association (SAGA). SAGA was founded in 1977 with the aim of fostering and encouraging the development of geophysics in South Africa. The association currently boasts a membership of some 350 people world wide.

Lindsay is also the national delegate of the International Association of Seismology and Physics of the Earth's Interior (IASPEI) and reports to the International Union of Geophysics and Geodesy (IUGG). "I enjoy this tremendously because it allows me the chance keep in touch with wider applications of geophysics and to meet scientists who have specialised in fields like oceanography, geodesy and vulcanology," she says.

### Sources of inspiration

So what inspires Lindsay to keep scaling new heights? "My love for science and the support of my husband, Patrick, who is a great applied mathematician," she answers. "And don't forget that I work with two brilliant seismologists," she continues, referring to her role models and mentors, Dr Ray Durrheim and Dr Steve Spottiswoode. "In fact, our team of mining seismologists is the biggest group in the world," she adds.

As a child, she looked up to her geologist father, and her late-grandfather who was an orthopaedic surgeon. In fact, she says she was torn between which career to follow. "In the end, it was the love of maths and rocks that won, and here I am!" she proclaims.

### What's in the future

Looking ahead, Lindsay plans to do more research on excavation sources, looking into how stopes interact with sources. This will be done between relaxing moments of life-drawing, sewing (she is a keen dressmaker and quilter) and making jewellery. "These are my creative outlets," she says.

To aspiring geophysicists out there, she recommends curiosity, honesty and hard work – attributes that ensured her story has a happy ending. **– Tlhagi Mokhema**

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This special edition of **ScienceScope** is an initiative of CSIR Communication in support of **National Women's Month**.

With the theme "**Women in Science**", it showcases the research outcomes of a selection of CSIR staff.

The CSIR employs in the order of 1 200 scientists, able to serve as role models for future generations and to demonstrate the positive impact of science, engineering and technology on socio-economic development.

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**Printing:** Lesogo Print & Marketing, tel: (011) 614-5881

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