

NMMU Research Report



Nelson Mandela
Metropolitan
University
for tomorrow

2014/2015

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“We can change the world and make it a better place. It is in your hands to make a difference”
- **Nelson Mandela**

Vice-Chancellor's Report



I gives me great pleasure to introduce the 2014 NMMU Annual Research Report, which provides a summary overview of a wide range of research and innovation initiatives undertaken by our staff and students during that year.

The 2014 research agenda reflects, in a large measure, efforts by our research community to respond to the strategic imperatives arising from NMMU's Vision 2020. Our vision commits NMMU to work towards a more equal, inclusive and sustainable society, using knowledge for the promotion of public good. Specifically, as the Report will show, our research community is committed to utilising their discoveries and innovations to tackle many of the great social challenges of our time – poverty and social inequality, unemployment, social polarisation and crime, economic development and reducing anthropogenic stresses on the natural environment.

Towards this end, the research agenda has been organised around a set number of niche research themes cutting across NMMU's seven faculties – Science, Health Sciences, Arts and Humanities, Education, Law, Business and Economics, and Engineering, Built Environment and Information Technology (EBEIT). Our researchers are engaged in a range of exciting frontier projects aligned to our country and continent – including building healthier societies, discovering new energy sources and developing novel materials, improving quality of food security, sustainable human settlement, improving quality of public schooling, entrepreneurship, law and social justice, and understanding the origins of modern humans on the coastal landscapes of South Africa.

2014 has seen a significant increase in overall levels of investment towards bolstering and upgrading NMMU's research infrastructure, human capabilities and outputs. Although the capability spread is still uneven across different research niches, significant strides have been made in ramping up new areas, and encouragingly, trans-disciplinary projects. There has been an increase in the overall number of rated researchers, including new generation researchers. We have seen the development of new and the modernisation of older research infrastructure in key faculties such as Science, EBEIT and Health Sciences, including laboratories, equipment, library facilities and information support technologies. These interventions have grown the size of NMMU's overall research asset base and capabilities, which in turn has enabled our researchers to recruit more post-graduate students and post-doctoral expertise to engage in more expansive research and development work than previously.

I would like to thank the university research community for their commitment and passion in promoting Vision 2020. Without their generous support, participation and creativity, this wonderful portfolio of research work and innovation would not have been possible. Through their innovative work, NMMU demonstrates its solid commitment to being a socially engaged and progressive university.

Prof Derrick Swartz
Vice-Chancellor

“Our researchers are committed to utilising their discoveries and innovations to tackle many of the great social challenges of our time.”

Deputy Vice-Chancellor: Research and Engagement's report



It is with great pleasure that I write this foreword for NMMU's Research Report for 2014. The report highlights the incredible progress we have made since our establishment through the merger in 2005.

Together with Teaching and Learning, Research and Engagement frame the Academic Project which is at the heart of our Institution.

We have worked hard to ensure that the principles of Research and Engagement are firmly embedded in our curricula and are taught to all our students from first year through to doctoral level, so that, upon graduating, they have these necessary skills for the world of work.

Our vision is "to be a dynamic African University, recognised for its leadership in generating cutting-edge knowledge for a sustainable future". Consequently, we strive to be leaders in key niche areas that will make a practical and meaningful difference in our communities – both in our region and across the continent.

The Report celebrates the successes we have achieved in 2014. These success stories are spread across all our Faculties. The Fast Facts (pages 6 to 7) provide a succinct summary of the tremendous achievements, for which we are delighted and proud. We have grown our capacity across the institution – as reflected in the significant increase in the proportion of our staff with completed doctorates, as well as the growth in the number of NRF-rated researchers, the number of Research and Engagement Entities, and the number of Research Chairs. All this has enabled the Institution to dramatically increase the number of postgraduate (masters and doctoral) students, with the resulting increase in NMMU's graduation rates.

Worthy of special note is the progress NMMU has made in developing Marine and Maritime as one of the flagship areas for which our University is becoming increasingly recognised. Other areas are also worth notable mention, and we proudly showcase them in the Report. Special mention can be made of the growing research endeavours in our Faculty of Health Sciences (under the umbrella of Health and Wellbeing), and our Social Sciences and Humanities (see Arts and Humanities). We have also put much energy into growing the trans-disciplinarity (Integrated Research) focus of our Research and Engagement activities, as the bringing together of various disciplines under the umbrella of defined institutional research themes enables one to pool resources and intellectual capacity so as to achieve greatest impact, in line with our Vision.

We have also made great advances in Innovation and Engagement, led primarily by the pioneering work that is taking place in

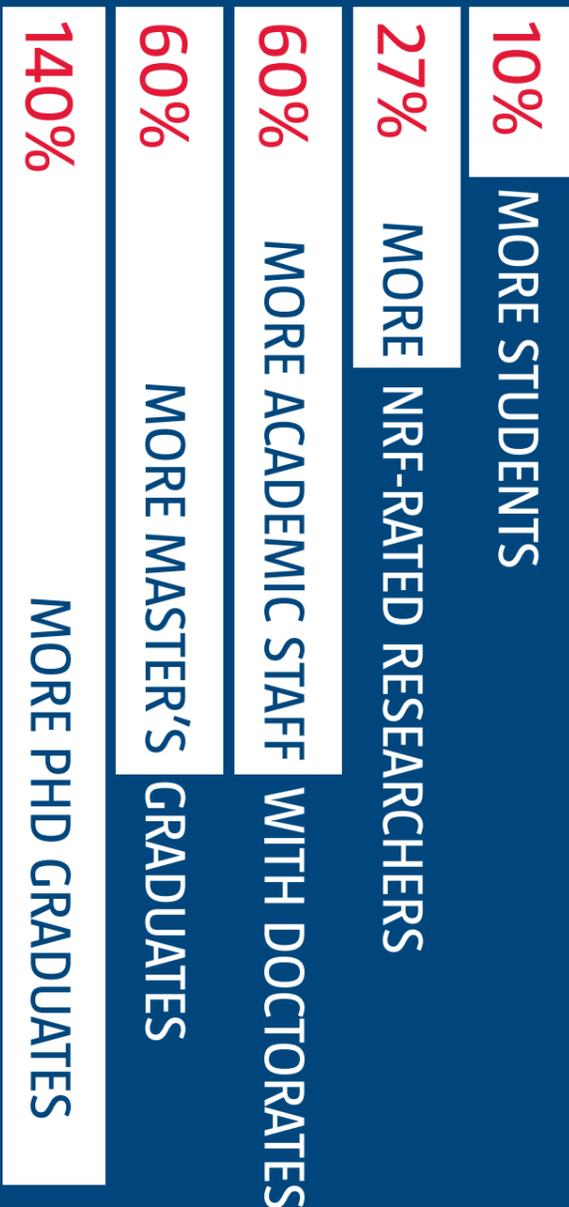
Innovention and eNtsa. The establishment of Propella provides us with a vehicle through which embryonic commercialisation ventures – often flowing out of student research projects – can be provided with the necessary support that will ultimately lead to job creation.

The Report provides fascinating reading of our many Research and Engagement initiatives which will serve the NMMU well into the future. Enjoy!

“ We strive to be leaders in key niche areas that will make a practical and meaningful difference in our communities – both in our region and across the continent. ”

Fast Facts

Nelson Mandela Metropolitan University was formed in 2005, following the merger between the University of Port Elizabeth, PE Technikon and Vista University's Missionvale Campus. Milestones over the past 10 years include the following:



10% Over the past year, NMMU has experienced a 10% growth in its Department of Higher Education and Training (DHET) subsidy units. (These relate to high level research outputs in the form of peer-reviewed journal articles, books and book chapters, conference proceedings, masters and doctoral graduates and patents.)

16% 16% of these units were published in the School of Life Sciences, in the Faculty of Health Sciences.



By 2014 278 academics obtained doctoral degrees

At graduation 2014, NMMU celebrated 72 PhD & 448 doctorates masters



REPUTATIONS AND RANKINGS

- NMMU's Business School was the first in South Africa to receive official "green" design rating accreditation for a public and education building from the Green Building Council of South Africa (GBCSA).
- The Business School was also elected onto the European Doctoral Programmes' Association in Management and Business Administration (EDAMBA) – becoming the second Business School in Africa with links to this prestigious association.

TOP NRF-RATED RESEARCHERS

A1-RATED RESEARCHERS

Nelson Mandela Metropolitan University is among South Africa's top 10 universities, in terms of the number of researchers who have research ratings from the National Research Foundation (NRF). In 2014, the university had 77 NRF-rated researchers, up slightly from 73 the previous year.

For the full list of rated NRF researchers at NMMU, go to the following link: <http://rm.nmmu.ac.za/Rated-Researchers-at-NMMU>



FROM CRITICAL CONSERVATION PROJECTS TO ANCIENT LANDSCAPES

— Prof Richard Cowling,
internationally recognised ecologist

PROFESSOR of Botany Richard Cowling is recognised as a world-leading ecologist and conservation scientist. Although he trained as a plant ecologist, the A1-rated research professor has always had a strong interest in conservation and “an insatiable curiosity about the evolution of biodiversity”. The latter has led him to projects like the South African Coast Paleoclimate, Paleoenvironment, Paleoecology, and Paleoanthropology project (SACP4) project, which is investigating areas along the Southern Cape, which have been linked to the evolution of modern human beings as well as the evolution of Cape flora.

Cowling is one of two co-principal investigators in this project, which is led by palaeoanthropologist Prof Curtis Marean, from the Institute of Human Origins at Arizona State University, and funded by the National Science Foundation (United States). Linked to this project, Cowling and Marean were instrumental in establishing NMMU's Centre for Coastal Palaeosciences, which was launched in 2015.

“I am interested in the identification of palaeoscapes [ancient landscapes] that sustained the evolution of modern humans along the South African Cape coast.” (Cowling's research in this project is profiled on page 36 of this report).

His interest in conservation has most recently seen him working together with researchers from Rhodes and Stellenbosch universities to drive an ecological, rather than agricultural, focus on developing crops for South Africa's newly-emerging honeybush industry.

“We don't want to see with honeybush what happened to rooibos [both are fynbos species], where the industry developed cultivars and encouraged the ploughing of virgin veld. What happened was that dozens of fynbos species became threatened and many of the varieties of rooibos were lost forever ... Ecology and biodiversity principles must be followed in developing the crop.” The demand for honeybush tea, which is naturally sweet and has properties

that reduce the symptoms of diabetes, has taken off in the last five years. “Sugar is the new tobacco ... The demand for honeybush tea will go up even more.”

“My conservation experience has led me towards the social sciences, since conservation is mostly about the choices humans make,” said Cowling, who holds a distinguished professorship at NMMU.

Cowling has authored or co-authored over 550 publications, and has delivered over 200 papers at conferences. He has supervised 59 MSc and PhD students and has mentored 15 postdoctoral associates. He has served on the editorial boards of 13 journals.

In addition to his formal academic career, he has engaged in numerous community-based projects dealing with the conservation of South Africa's flora and vegetation. He has served on 22 civil society committees (many of which he has chaired) and authored 60 articles and four books in the popular media.

He has won a string of awards for his research and community outreach work, including most recently the South African Association of Botanists' (SAAB) Gold Medal for Botany Award, awarded for outstanding botanical research and contributions to the advancement of botany in the country. It is only awarded to exceptional candidates – Cowling is the 12th recipient in the award's 46-year history.

DEFINING A NEW SCIENCE TO SOLVE THE PLANET'S PROBLEMS

— Prof Maarten de Wit,
tackling earth's challenges



PROF Maarten de Wit, an A1-rated researcher, has defined a completely new discipline – Earth Stewardship Science – to holistically tackle problems affecting the planet, its commons (shared resources) and people. This trans-disciplinary field of research links science, technology, engineering and maths (STEM) and the humanities – and the problems on which De Wit and his colleagues and students are focusing are varied, yet all critical to Earth's existing and future care. They range from climate change and pollution to poverty, poor health care, education and more.

Within this context, he is also leading NMMU's Karoo Shale Gas Group, which is looking at the potential consequences that could result from the exploitation of the Karoo for shale gas harvesting. (For a broader overview, see story on page 32)

He has also co-written a newly-published book called “Geology and Resource Potential of the Congo Basin”. The book provides an up-to-date analysis of the origin and evolution of this major intra-continental sedimentary basin, about which little is known.

The concept of Earth Stewardship Science was conceived in De Wit's Africa Earth Observatory Network (AEON), 10 years ago, giving rise to hubs at universities across the country. “This institute was set up by 18 scientists in different disciplines, from the humanities to hard physics. Our aim was to solve the planet's future and emerging problems – this can only be done as a team.” Based at NMMU, AEON is linked to NMMU's newly-established trans-disciplinary Earth Stewardship Science Research Institute – and is known as AEON-ESSRI.

De Wit completed his PhD in Geosciences at Cambridge University. From there, he spent four years at Columbia University in New York, conducting most of his field work in Chile, trying to understand the origin of the Andes and how this mountain range connected with Antarctica. He then left academia to join the United Nations, training geologists in Ethiopia for two years. Disillusioned

with UN work, he returned to Europe to cycle around the continent for a year. A chance meeting with an inspiring South African professor in a pub in Amsterdam was the catalyst for his coming to South Africa in 1979.

He spent 10 years at the University of the Witwatersrand's Bernard Price Institute of Geophysics researching rocks – some 3,5-billion years old – in Mpumalanga's Barberton area, to unravel the story of early Earth and life, which continues to be his fundamental research arena. He moved to UCT in 1989, where he founded the Centre for Interactive Graphical Computing in the 1990s, which evolved into Earth Stewardship, and was renamed AEON in the mid-2000s.

In addition to its extensive African links, AEON's international partners include, among others, the Massachusetts Institute of Technology (MIT), United States, the Institute Physique du Globe in Paris (IPGP) and Germany's National Research Centre for Earth Sciences (GFZ) in Potsdam.

Through AEON, De Wit set up Inkaba yeAfrica and !Khure Africa, collaborative capacity-building earth systems programmes between South Africa, Germany and France, respectively. Recently these two programmes have merged into “Iphakade” (meaning “observe the present and consider the past to ponder the future”), AEON-ESSRI's flagship trans-disciplinary research programme.

De Wit has authored or co-authored about 225 papers, and delivered about 350 conference papers. In 2013, he was awarded a prestigious Gold Award from the Southern Africa Association for the Advancement of Science (S.A.).

B1-RATED RESEARCHERS



FLOW TECHNOLOGY: MANUFACTURING DRUGS FOR AFRICA

— Prof Paul Watts, pursuing next generation chemistry

PROF Paul Watts is making anti-HIV/Aids drugs, using a small flow- or micro-reactor: It is essentially one long glass tube, bent like a sidewinder snake, which allows him to pump in materials and reagents (reaction mixtures) at different points along the way, enabling numerous chemical reactions to occur in parallel, with the final product emerging at the end.

“South Africa doesn’t have a chemical manufacturing industry ... The question is: Can we create one by exploiting new technology such as this? Can we, more cheaply, manufacture drugs for the African market? And if we can, what’s the next basis it can be used for?”

This smaller, greener, cheaper and safer conveyor-belt approach to chemical processing – called flow chemistry – is gaining popularity in Europe, where the challenge for scientists is whether to stick with traditional batch reactors or switch to flow reactors.

With flow chemistry, which is only about 15 years old, researchers can conduct as many as 200 experiments daily on a minute scale and stop them in process if necessary. It is world’s way from traditional batch processing, where researchers would complete one or two costly experiments per day, on a much larger scale, with much higher risks should things go wrong.

Watts – who has a B1-rating from the National Research Foundation, and holds NMMU’s research chair in Microfluidic Bio/Chemical Processing, situated within InnoVenton, the university’s institute for Chemical Technology – is manufacturing the anti-HIV/Aids drugs for Aspen Pharmaceuticals, with materials sourced from India.

He says the flow chemistry technology is suitable for large-scale manufacturing. “A tiny micro-reactor [which he can hold in his hand] can produce 10kg a day.” Watts also wants to test whether, using this same type of approach, raw natural products (from South African plants) can be pumped into the reactor,

together with other materials, to emerge as value-added products. “Doing several processes together is a lot less polluting and produces a lot less waste.”

The planned plant research will further reinforce NMMU’s reputation as the leading university in South Africa in what is known as Downstream Chemistry, which looks at the recovery and purification of biosynthetic products, particularly pharmaceuticals, from natural sources such as animal or plant tissues.

Watts obtained his doctorate in bio-organic natural product chemistry at Bristol University before moving to Hull University where he led the micro reactor and continuous flow technology group. He is on several editorial boards, is an associate editor of the *Journal of Flow Chemistry* and is well connected with other researchers in his field in Europe and the United States.

He has published 102 peer-reviewed articles, authored one book and 14 book chapters, and has six patents behind his name. He has also presented 138 conference papers. He has supervised 12 doctoral and masters students, and 12 postdoctoral students.

STRENGTHENING GLOBAL RESEARCH ON WOMEN’S CAREER DEVELOPMENT RESEARCH

— Prof Mark Watson, mapping career trends



A GROUNDBREAKING book looking at career development patterns among women aged 45 to 65 across the globe is challenging perspectives about women in the work place.

“We felt that career theory and career measurement were too male-dominated,” said B1-rated Professor of Psychology Mark Watson, one of the book’s three joint editors. “Women’s patterns of career development are complex. Women are very resilient.”

Published in January 2015 under the title, “Women’s career development throughout the lifespan: An international exploration”, it is one of three career-focused books with which Watson has most recently been involved. The book began as a study of career transitions and the multiple life roles carried by women in South Africa, Australia and England, but soon expanded to include women in Germany, Italy, Argentina, Canada, China and Portugal.

“Each country had a principle researcher who interviewed 12 women ... The book allows readers to listen to the voices of the 108 women.” The three editors, who included Prof Jenny Bimrose from the University of Warwick, United Kingdom, and Dr Mary McMahon from the University of Queensland, Australia (both of whom are NMMU research associates), invited top international career researchers and theorists to offer their opinions on the material collected, which were also included in the book.

“Despite the differences in socio-economic backgrounds and nationalities, there were a lot of similarities ... Through what these women say, the book challenges current ideas about career development.” The book also confirms that despite the introduction of equal employment legislation in many countries, the proverbial glass ceiling still exists for women.

A second recently-published book focuses on a qualitative approach to career assessment. “Since 2000, there has been a movement away from quantitative

career assessment, such as psychometric testing. This type of testing is useful, but a qualitative approach takes into account that everyone has a story to tell about career development and it’s better to get the context of the person, their background and the factors influencing their life.

“Nobody has yet put together a book on the qualitative assessment of career development ... There are about 14 world experts who have developed qualitative ways of looking at career development, including instruments. This book explains how they are used.” This is the first book on the qualitative assessment of career development. Initial reviews have called it a “landmark text”. A third book that will be published in early 2016 focuses on how to stimulate career awareness in children.

Watson has also been working on the third edition of the book “Career psychology in the South African context”, which is prescribed on various campuses. Watson holds a distinguished professorship at NMMU, an honorary professorship at the University of Queensland and a Research Fellowship at the University of Warwick.

At NMMU, he mentors “promising future academics” through the Next Generation Initiative (NGI) programme. “They are all completing doctorates attached to various schools and departments.” Together with McMahon, he has been devising a standardised programme of training for career practitioners in South Africa. A member of the National Research Foundation’s Executive Evaluation Committee, Watson has authored or co-authored 48 books/ book chapters. He was awarded NMMU’s Faculty of Health Sciences Researcher of the Year Award in 2006, 2008, 2009, 2013 and 2014.

2014 RESEARCHER OF THE YEAR AWARDS:

2014 RESEARCH AWARD WINNERS

The main purpose of NMMU's annual Research Awards is to recognise those who have made significant contributions towards research – particularly through high impact and quality academic research outputs. Other factors taken into account include publications, conference involvement, supervision of postgraduate students, national and international recognition, research grants and human capital development.



NMMU RESEARCHER OF THE YEAR 2014:

PROF JAN NEETHLING PASSIONATE PROBLEM SOLVER

VISIONARY ... Prof Jan Neethling, head of NMMU's Centre for High Resolution Transmission Electron Microscopy (HRTEM), was named NMMU's top researcher for 2014.

FOR 12 years, NMMU'S Prof Jan Neethling campaigned for the establishment of a High Resolution Transmission Electron Microscopy centre in South Africa, to allow scientists to investigate the tiniest components in materials, like atoms.

From the time it eventually opened its doors at NMMU in 2011, having received government approval three years earlier, Neethling, the centre's director, and his team wasted no time in contributing to national and international research and even solving problems scientists have been grappling with for decades.

The physics professor admits his passion for solving scientific problems borders on the obsessive – but his hard work has resulted in NMMU's top honours for research, with Neethling named NMMU's Researcher of the Year for 2014.

The HRTEM housed in the world-class centre is a first for Africa. It works by shooting a beam of high speed electrons through a thin specimen of material to be analysed. The transmitted beam is focused on a specimen and a magnified image of the specimen – magnifying it a mind-boggling 400 000 to 800 000 times – is formed by the electromagnetic lenses of the electron microscope, thus allowing scientists to see right down to the tiny atoms making up the material and detect the minutest crystal defects.

"We are working at the same level as the best laboratories overseas ... With the HRTEM, it has now been possible to solve problems that have been mysteries to international researchers for many decades, e.g. how radioactive silver escapes from fuel particles used in pebble bed type reactors, why diamond drill bit inserts in oil drills degrade during drilling operations, and what the nano crystal structure of a certain platinum-silver alloy is.

"Atomic resolution imaging has also provided important new information on a range of materials, several of which are considered to be key materials in future improved nuclear reactor designs."

What is also special about NMMU's HRTEM is that it is "aberration-corrected",

which rules out any blurring at the atomic level which is common to HRTEMs without this function.

The wide range of materials being investigated by Neethling and his team include ceramics used in nuclear fission reactors, nanoparticle catalysts, nanophosphors, semiconductors, polycrystalline diamond products, natural diamonds, metal alloys, nuclear grade graphite, oxide dispersion strengthened ferritic steels, graphene and platinum alloys.

"Nanoscience [where materials are analysed at an atomic level] has the potential to significantly enhance the properties of a wide range of products. It has already made important contributions to fields such as electricity, computers, cell phones, clean water and air and space travel.

"All these technologies depend on special materials which were developed and optimised by characterizing them at the micro- and nanoscale." Neethling, who is president of the Microscopy Society of Southern Africa, has close research collaboration with a number of research institutions and universities in South Africa, Japan, Russia, Germany, Sweden, the United Kingdom and the United States.

The centre last year hosted an international workshop attended by prominent academics from the United States, the United Kingdom and Australia, which focused on the use of advanced electron microscopy for research on titanium and aluminium alloys as well as the platinum group metals.

"By becoming part of a high-level international research network, we hope to advance materials development in South Africa and abroad – with the ultimate aim that this should contribute towards the energy security, mineral beneficiation and nanoscience ideals of South Africa and lead to new job opportunities."

The workshop also laid the foundations for the training of scientists and students in advanced electron microscopy, advanced materials research and materials modelling.

Neethling, a C2-rated researcher, has achieved 17 notable research acknowledgements and awards, including the Ernest Oppenheimer Memorial Trust Gold Medal Award. He has authored or co-authored more than 93 refereed articles in journals and more than 175 refereed conference proceedings, and has supervised or co-supervised 22 masters and 17 doctoral students.

He has spent sabbaticals as visiting scientist and guest professor at the Max-Planck-Institute for Metals Research in Stuttgart, Germany; the Humboldt University in Berlin, Germany; the University of Antwerp, Belgium; and Delft University of Technology, The Netherlands.

"I like to solve problems and understand how things work – from electron microscopes and the physics of materials down to very small atoms, electrons, protons, neutrons, and photons, to astronomy and the big outer space."

RESEARCH EXCELLENCE AWARD:

- PROF KHALED ABOU-EL-HOSSEIN
- PROF THOKO MAYEKISO
- PROF PRAKASH SINGH

PERFORMING AND CREATIVE ARTS AWARDS:

- MARY DUKER (VISUAL ARTS)
- ANDRIETTA WENTZEL (VISUAL ARTS)

INNOVATION AND TECHNOLOGY TRANSFER AWARDS:

- INNOVATION TEAM AWARD: GOVAN MBEKI MATHEMATICS DEVELOPMENT UNIT (LED BY PROF WERNER OLIVIER)

INSTITUTIONAL RESEARCH THEMES

NMMU has 13 institutional research themes, which are in the process of being further developed to align more closely with national, regional and institutional priorities. The inter-disciplinary nature of these themes is also being expanded.

The 13 themes are:

- Science, mathematics and technology education for society (SMTE)
- Sustainable local economic development
- Cyber citizenship
- Manufacturing technology and engineering
- Nanoscale materials characterisation, new materials and processes
- Strategic energy technologies
- Sustainable human settlements
- Coastal marine and shallow water ecosystems
- Humanising pedagogies
- Democratisation, conflict and poverty
- Biodiversity conservation and restoration
- Health and wellbeing
- Earth stewardship science

FACULTY:	FACULTY RESEARCHER OF THE YEAR:	FACULTY EMERGING RESEARCHER OF THE YEAR:
ARTS	Prof Bert Olivier	Dr Marius Crous
BUSINESS	Prof Chantal Rootman	Dr Michael Sale
EDUCATION	Prof Prakash Singh	Dr Chris Dali
EBEIT*	Prof Rossouw von Solms	Dr Nicky Mostert-Phipps
HEALTH SCIENCES	Prof Mark Watson	Dr Portia Jordan
LAW	Prof Avinash Govindjee	-
SCIENCE	Prof Richard Cowling	Dr Ronel Nel

*Engineering, Built Environment and IT

FLAGSHIP PROJECTS

HEALTH AND WELLBEING

As NMMU takes strides towards the establishment of a fully-fledged medical school – following a bottom-up approach, tailored towards meeting the province’s most urgent medical needs – there is, appropriately, an increasing research focus in the area of health. Outlined on the following pages, are a collection of stories, across a number of faculties and disciplines, that showcase the university’s diverse and innovative research in this critical area.

TECHNOLOGY BOOST FOR SCHOOL NURSES

A PIONEERING mobile app has enabled school nurses in rural areas of the Eastern Cape to use tablets and cell phones to more effectively assess the health of learners.

Developed by the Centre for Community Technologies (CCT), and originally funded by the Department of Science and Technology as the mobile health sector of their Technology for Rural Education (Tech4RED) initiative, the app has been so successful in its two-year Eastern Cape pilot phase that there are plans to roll it out nationally.

Previously, the paper-based screening of learners was lengthy and time-consuming. “Nurses used to only screen 20 learners per day. They can now screen up to 90,” said CCT director Prof Darelle van Greunen, who has a C2 NRF rating.

“What has also happened is that there now appears to be more faith in the ability of the nurses because they are using technology. They are perceived as being more professional and teachers are doing more referrals – the status of the school nurse has been elevated.”

Children’s fear of the school nurse has also disappeared. “Where children used to be scared, they’re now intrigued by the technology.”

Through the app, everything the traditional school nurse has had to test for has been linked to mobile devices – from measuring blood pressure and pulse rate, to conducting blood tests for diabetes. Also connected to mobile devices are stethoscopes, designed to measure heart murmurs in children, and blue-tooth scales that automatically calculate body mass index.

The data is then filed away in cyber space, effectively creating a health profile for patients that is non-reliant on old-fashioned clinic cards. Through Tech4RED, the mobile app was successfully piloted in the rural Cofimvaba area

from July 2013 to 2015. Based on this, the National Department of Health has requested that the CCT join a national task team, which will essentially draw together into one solution the country’s best initiatives in mobile school health technology, which can then be rolled out to schools throughout the rest of the country.

Van Greunen said: “What it will involve is that every school health team will receive tablet PCs and related tools to equip them to assess according to the integrated school health policy (2012) of South Africa.” This will include vaccinations, including the Human Papilloma Virus (HPV) vaccination for girls to reduce cervical cancer, making referrals for vision and hearing, deworming, and so on.

“The project will be rolled out to 52 districts, equating to 2000 school health teams, with the first phase commencing in 2016.”

Van Greunen said the CCT-developed mobile app had proven to have a number of benefits: It allowed all the data collected to be written to a central database, allowing the relevant sub-district of the Department of Health to report more accurately on certain health indicators, as dictated by the National Department of Health. It has also allowed for early detection and intervention relating to certain diseases and disabilities, including learning disabilities.

“Through the app, one nurse discovered a child suffering from epilepsy was on the wrong medication, and was able to refer him to the sub-district clinic. He was taking the dosage of an adult male, but he was only nine.”

Van Greunen has delivered 21 international keynote addresses. She has written one book, three book chapters and 14 journal articles, and delivered presentations at 128 conference.

Over 2014, NMMU celebrated a number of flagship research projects, of which the institution is particularly proud. Some fit within the institutional themes (listed on page 11), while others have expanded beyond their boundaries into other areas.

IMPROVING COMMUNITY HEALTH-CARE

IN a parallel project, the CCT together with the Medical Research Council (MRC), which is the research arm of the National Department of Health, is also developing state-of-the-art interactive educational material for use by community care workers and primary health care professionals in rural areas.

“The MRC is providing the material and we are digitising and contextualising it for the different regions,” said Van Greunen.

“We are including material relating to the infectious chronic disease burden [e.g. TB and HIV/Aids] along with non-communicable chronic diseases, such as diabetes and hypertension.”

The interactive multi-media and visual technologies will bring information to life. For instance, one visual image is an eye which can rotate to reveal vein patterns typical in people with diabetes. “This material refreshes the knowledge of care workers ... Sometimes treatments have changed from what people learned a few years ago.”

The information will be loaded onto tablets for care workers, while clinics will be provided with a PC containing the material.

“Through the MRC, the project will be made available to the national Department of Health for distribution to all primary health care professionals that they deem necessary.”

CONNECTED ...Prof Darelle van Greunen, head of NMMU’s Centre for Community Technologies (CCT), teaches nurses how to interact with a new health app that will help them to be more effective in assessing learners’ health.





NMMU Human Movement Sciences Associate Professor Cheryl Walter is the South African coordinator of a pioneering Disease, Activity and School Children's Health (DASH) study, led by NMMU in partnership with Switzerland's University of Basel.

HOW POVERTY-LINKED DISEASES AFFECT SA SCHOOL CHILDREN

In the first phase of a three-year South African-Swiss study on poverty-related diseases in South African school children, mass treatment for worms (helminth infection) was administered at three Port Elizabeth schools.

The treatment was based on World Health Organisation (WHO) guidelines, for infection rates exceeding 20% of the community. At two of the three schools, which were all in the city's impoverished Northern Areas, the infection rate was higher than 50%.

The groundbreaking Disease, Activity and Schoolchildren's Health (DASH) study – run by NMMU in partnership with the University of Basel in Switzerland – is also testing for non-infectious, chronic conditions like diabetes, obesity and malnutrition.

"Studies have revealed that South Africa has shifted towards a disease profile similar to that of Western countries, with increasing numbers of deaths attributed to chronic diseases. However, despite this shift, infectious diseases that are intimately connected to poor living conditions and poverty continue to occur in marginalised communities, and affect school-aged children in poor neighbourhoods of South Africa," said Human Movement Sciences Associate Professor Cheryl Walter, who is the DASH Study Coordinator in South Africa. She has seven published journal articles.

"The in-depth DASH study is providing new insights into the impact of this double burden of disease, on children's physical fitness, cognitive performance and psychosocial health."

The data collected through the DASH study, which is funded by the Swiss National Science Foundation (SNSF) and the National Research Foundation (NRF), is also being used to tailor school-specific interventions to improve children's health and wellbeing in South Africa.

"While there is much data available about the poor living conditions of many South Africans, we don't know what the burden of disease is on children's health," said Walter.

The study, which started in 2014 and will run until early 2017, is compiling health and wellbeing profiles for 1000 Grade 4 children, aged between 9 and 12, at eight disadvantaged township and Northern Area schools in Port

Elizabeth. The standardised data will be used to compare South African children with those in other countries worldwide.

So far, the baseline testing phase has been completed, where research teams carried out a broad range of tests on the pupils, which ranged from medical examinations and fitness tests, to academic and psycho-social questionnaires as well as the testing of urine, blood and stool samples for infectious diseases. The next phase – intervention – started at the end of 2015.

The research project is spearheaded by Prof Uwe Pulse from the University of Basel, but coordinated at NMMU by Walter, in collaboration with NMMU School of Lifestyle Sciences Director Prof Rosa du Randt.

Commenting on the particularly high incidence of worms at the three previously-disadvantaged Northern Area schools, Walter said: "It boils down to poor health and hygiene, like not washing hands." Infection less than 20% was reported at the other five schools.

In addition, 67 children were referred to local clinics based on severe infections picked up through the urine and stool testing, along with cases of hypertension and ringworm. "We will follow up to check whether they have received treatment ... These children were excluded from the fitness testing."

The testing team comprised of postgraduate students from the University of Basel and NMMU, assisted by Biokinetics interns and students from HMS, Psychology and Nursing, along with retired nurses and community volunteers.

Walter said the teams had also monitored the schools' feeding programmes, and picked up a number of health and hygiene issues. "We have trained servers on the preparation of foods. Our health and hygiene programme has included the basics, like washing of hands."

Walter said 103 schools had been approached to participate in the project. Twenty-five schools responded positively and eight of these were selected, based on their size, geographical location and commitment to the project objectives.

DID YOU KNOW?

- Half of South African children are not active enough and obesity rates are on the rise. In South Africa, in the 10-14 age group, 10% of boys and 23% of girls are overweight or obese. In the 15 to 17 age group, 9% of boys and 27% of girls are overweight or obese.
- South African children watch almost three hours of TV every week day – and more on weekends.
- Over two thirds of adolescents eat fast food at least three times a week.
- On average, South African children and adolescents consume 50g and 100g of sugar per day, respectively.
- Sweetened cooldrinks contribute to this high sugar intake, with two in three learners purchasing sugar-sweetened beverages at least twice a week.
- As a nation, South Africans drink three times the global average of certain soft drinks.



EAGER TO EXERCISE ... Children at a Port Elizabeth township school participate in fitness tests, run by students from NMMU and the University of Basel, Switzerland.

A IS FOR "ACTIVE"

Walter also oversees the PasSPORT to Health project, the acronym standing for Promoting Physical Activity in School Sport, which is run by third-year Human Movement Sciences students. How this project works is that the students are divided into three groups, each selecting a disadvantaged school with which to collaborate. The students fundraise between R10 000 and R15 000 to set up simple physical fitness games and activity stations in the playgrounds, based on a needs analysis determined by speaking to the pupils and teachers of each school.

"The aim of the project is to promote physical activity and sports at these schools. "We measured children's physical activity pre and post-intervention [using accelerometers strapped around the children's waists] – and have found that in a physical fitness-friendly playground, children play more."

THE COMPLEX CASE OF TB OUTSIDE THE LUNGS

DRUG-RESISTANT Tuberculosis (TB) is not a disease unique to the lungs; the bacteria can also manifest in the lymph nodes or brain – or even in the gastro-enterological or urinary tracts of patients – where it usually goes undetected, with fatal results.

The epicentre of multi-drug resistant (MDR-TB) and extensively drug resistant TB (XDR-TB) in South Africa is the Eastern Cape, where a team of researchers are hoping to improve the diagnostic techniques of extra-pulmonary (outside the lungs), drug-resistant TB to enable patients to get treatment earlier. With MDR-TB, the TB bacteria are resistant to first line drugs while XDR-TB results when the bacteria are resistant to both first and second line drug treatments. “At the moment, we mostly only become aware of XDR-TB once the patient has died,” said biochemistry and microbiology lecturer Dr Sharlene Govender, who is working with National Health Laboratory Services’ Prof Colleen Wright and Stellenbosch University’s Prof Rob Warren, in the TB research group.

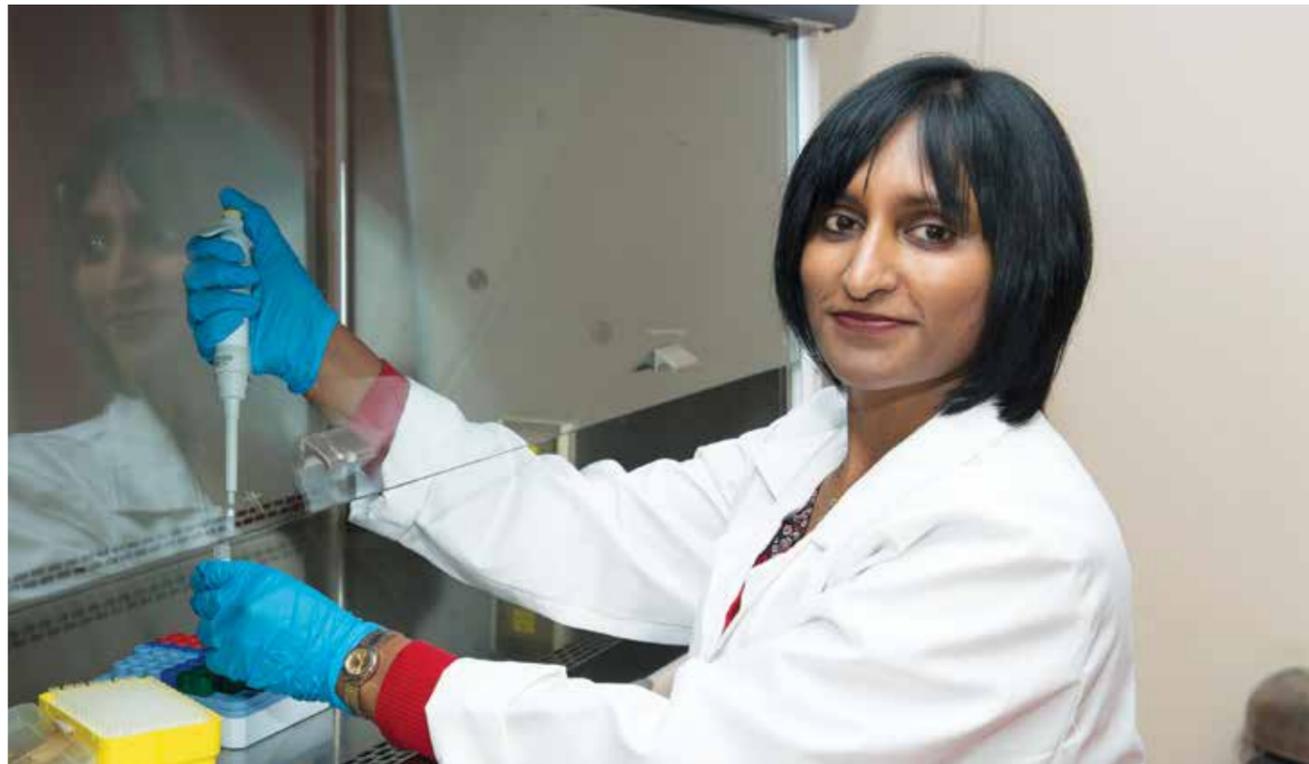
One of Govender’s students is also looking at the validity of the various extra-pulmonary TB diagnostic techniques on the market – many of which are awaiting approval from the World Health Organisation – to check for faster, more reliable results than those provided by the current WHO-endorsed kits

used in public labs. “Typically, by the time the diagnostic test has confirmed XDR-TB, the patient has also passed on.” She said the highest prevalence of extra-pulmonary XDR-TB was in the lymph nodes.

XDR-TB usually results when TB patients don’t complete their course of medication or skip days. “Often, they no longer feel sick so they stop taking their medicine.”

The TB research group is also looking at the prevalence of mutation patterns of drug resistant TB strains in the Eastern Cape. “So far, we have looked at 257 cases and have found a high number of mutations that are unique to the Eastern Cape. This implies that this region has a different strain of drug resistant TB.”

Govender a Y2-rated researcher with 15 published articles, and her students have also been testing medicinal plants for anti-TB and anti-HIV activity. “One Nigerian plant extract showed anti-TB activity. We tried to take this further, screening for compounds for anti-TB, but also need to consider toxicity levels, which requires further investigation.”



TESTING FOR TB ... NMMU biochemistry and microbiology lecturer Dr Sharlene Govender is part of a national TB research group.

DRUG-RESISTANT BACTERIA IN THE ICU

A HIP fracture in a 76-year-old woman in 2014 – and a subsequent operation in one of Port Elizabeth’s public hospitals to insert a prosthetic hip – was not without its risks. But her death several months later would not be from complications from the operation, but rather from multi-drug resistant bacteria found for the first time in the Eastern Cape.

Researching the case was microbiologist Dr Sharlene Govender and her postgraduate students, who discovered that the sinister superbug, *Pseudomonas aeruginosa*, most likely resulted from “a lack of antibiotic stewardship” by those responsible for her care. By looking into such cases, Govender aims to highlight the consequences of the abuse and misuse of antibiotics – and to enforce infection control. “We need more surveillance and monitoring [of hospitals] ... What we are seeing is quite disturbing.

What probably happened in the elderly woman’s case was that entero-bacteria (i.e. bacteria usually found in the gut) entered the wound through poor infection control, such as a nurse not washing her hands or sterilising equipment like catheters. The wound went septic but the high doses of antibiotic treatment administered in ICU four days after her operation were not designed to treat that particular strain of bacteria, leading to drug resistance.

Some weeks later, seven out of 17 doses of a more effective antibiotic treatment were not administered, leading to further drug resistance. “Unfortunately, patient files get lost and clinicians change over – and many doses were missed.”

The deterioration of the wound following the initial operation saw the woman returning to hospital for 19 weeks. But, with the antibiotics failing to treat the infection, it spread to other parts of her body – and she died.

“She was not given the correct antibiotic ... Typically, clinicians don’t test to see which bacteria they are treating, but give a broad spectrum antibiotic to treat a range of diseases. The negative side of this is the promotion of drug-resistant bacteria.”

Govender and her students also worked on another landmark case, where a multi-drug resistant form of bacteria (*Enterobacter asburiae*) was found for the first time in Africa, in a 34-year-old car accident patient. In this case, it was found to be an entero-bacteria previously reported to be from a river sample. Injuries to the man’s spine from the accident had led to quadriplegia, but the resistant bacteria led to lung complications (including ventilator-associated pneumonia) and severe bedsores. It is not sure where he picked up the bacteria, but it could have resulted from the accident itself, or the hospital.

The man’s condition improved with the change from antibiotic therapy to a fluoroquinolone – and he survived.

“This case report highlights the need for the rapid detection of antibiotic resistance determinants to optimise treatment options, improve clinical outcomes and limit the spread of highly resistant organisms.”



CONTAGIOUS ... A TB patient waits to see a doctor. Photographer: Alexander Joe, Getty images



IN QUARANTINE ... A young patient with drug-resistant TB sits in isolation in a South African hospital. Photographer: D. Taylor, www.voanews.com



HANDFULS OF PILLS ... A patient with drug-resistant TB takes his daily dose of pills. Source: www.thestar.com

ARE ANTIBIOTICS OVER-PRESCRIBED IN AFRICA?

RESearch has shown that antibiotics are typically over-prescribed in many Western countries – leading to drug-resistant and often deadly superbugs – but not nearly enough is known about the situation in Africa.

To fill in the blanks, the pioneering Medicines Utilisation Research in Africa (MURIA) group has been established. Its role is to monitor and compare antibiotics and other drug use trends from country to country across the continent and, through training, research and information sharing, improve the quality of medicine use and, in so doing, the quality of patients' lives.

"We're not exclusively looking at antibiotics, but we are looking to address common problems [related to medicine utilisation] in all the countries," said Nelson Mandela Metropolitan University Pharmacy Professor Ilse Truter, who heads up NMMU's Drug Utilisation Research Unit (DURU) and represents one of the three South African universities that were present at the inaugural meeting of MURIA at NMMU. The other two were North-West University and the University of KwaZulu-Natal.

MURIA is collaborating with Sweden's Karolinska Institute, based at Karolinska University Hospital in Stockholm, which will be comparing African drug use trends with other countries globally.

The group is also investigating the perceptions of health care workers regarding the overprescribing of antibiotics. MURIA includes medical doctors, pharmacists, statisticians and pure scientists from a broad spectrum of African countries, thus far including South Africa, Nigeria, Malawi, Kenya, Botswana, Namibia, Swaziland and Lesotho, but growing constantly.

Participating universities to date include the universities of Botswana, Namibia and Nairobi (Kenya) and, from Nigeria, Ekiti State University Teaching Hospital and Lagos State University College of Medicine and Teaching Hospital.

"MURIA is an open group for researchers to build capacity in Africa for drug utilisation studies ... There are a few researchers in Africa but not nearly enough," said Truter.

"Health systems in Africa differ from country to country. We want know what is happening in our neighbouring countries."

MURIA was initiated in 2014, with its first formal meeting taking place at NMMU in January 2015 and a second in Botswana in July 2015, with follow-up seminars and training workshops planned in the other participating countries.



AFRICA DRUG RESEARCH ... As a member of the newly-launched Medicines Utilisation Research in Africa (MURIA) group, Prof Ilse Truter is monitoring pharmaceutical drug usage trends across the continent.

STUDIES ON OVER-THE-COUNTER PAINKILLERS

SOUTH Africa is under the spotlight for using too much codeine – a common and potentially addictive component of some over-the-counter painkillers – but nobody knows the full extent of painkiller use, or possibly over-use, in this country, as very few statistics are available.

"We know painkillers are used a lot, but no one has ever done an on-the-ground study on the typical adult pattern of painkiller usage in South Africa. A lot of studies have been done [overseas] on painkillers, but relating specifically to cancer, backache, etc," said NMMU's Prof Ilse Truter, who in 2014 spearheaded consumer studies on the use of painkillers available without a prescription.

Truter, a C2-rated researcher who heads up NMMU's Drug Utilisation Research Unit (DURU), and her fourth-year students carried out consumer surveys on painkillers in supermarkets. Further studies were also conducted in pharmacies, and using prescription databases. They also tried to decipher the concept "over-use". "What is over-use? Is it using something every day? And what is the normal use of painkillers in South Africa?"

Their results showed that paracetamol was the painkiller most used, but many respondents also opted for paracetamol products in combination with codeine. However, it was difficult to conclusively prove in the studies if these painkillers were being abused or over-used. Follow-up studies are being conducted.

"There is a big drive in South Africa about responsible codeine use, otherwise South Africa may lose codeine as a component of over-the-counter medicines."

Although no detailed statistics on codeine addiction exist in South Africa, a report published by the International Narcotics Control Board in 2010 singled out South Africa for its high consumption of codeine, based on sales data from pharmaceutical companies. The study ranked South Africa 49th out of 193 countries globally for its use of codeine. The Medicines Control Council is considering changing its regulations regarding codeine, by reducing the amount of codeine in over-the-counter medicines, and possibly changing some schedule 2 products (available over-the-counter) to schedule 6 (available with a prescription).

In other research, Truter and her team are looking at the link between Attention Deficit Hyperactivity Disorder (ADHD) and substance abuse, as part of a wider study being carried out by the International Collaboration on ADHD and Substance Abuse (ICASA). "We want to see if there is a link between undiagnosed ADHD and possible substance abuse.

"What we are already seeing is that more and more adults are being diagnosed with ADHD and put on methylphenidate and other medications."

Studies on other central nervous system conditions, such as migraine and dementia, are also under way. Truter, who has two doctorates – one in business management and the other in pharmacy practice (focusing on pharmacoepidemiology, which studies the uses and effects of drugs) – has research links across Africa, Europe, Australia and Canada.

She has written 75 peer-reviewed articles and has presented over 400 papers. She was the Faculty of Health Sciences' researcher of the year for 2007, 2010, 2011 and 2012.



MEDICINAL PLANT ...
Prof Gill Dealtry is researching the anti-diabetic capabilities of the plant *Sutherlandia Frutescens*.

MEDICINAL PLANT RESEARCH CONTRIBUTING TO GLOBAL FIGHT AGAINST DIABETES

AN estimated 387 million people worldwide have diabetes, and this figure is expected to rise to 592 million by 2035, according to the International Diabetes Federation (IDF). Last year, diabetes caused 4.9 million deaths and cost at least \$612 billion in health expenditure.

IDF statistics show that South Africa has 2,7 million people with the disease and an estimated 1,2 million undiagnosed cases. Nearly 69 000 South Africans died from diabetes last year, and the health cost per person was \$950 (R11,400). An estimated 90% of South Africa's diabetics have type 2 diabetes, which is closely linked with lifestyle choices, such as diet, weight, exercise and stress levels.

These figures paint a sobering picture of the only disease for which there is a United Nations Resolution, affirming diabetes as a major global health threat. Joining the global fight against the disease is Prof Gill Dealtry, Director of the School of Biomolecular and Chemical Sciences who, with funding from the National Research Foundation, is investigating the anti-diabetic capabilities of a medicinal plant.

"*Sutherlandia Frutescens* is a plant that has been used traditionally by African people – and was also used by the early white settlers – to treat a range of different conditions," said Dealtry, an associate-professor of Physiology, who with her colleagues and postgraduate students has already poured years or research into the plant, proving a number of anti-diabetic capabilities using in-vitro (test-tube) and rat models, which has led to an over-the-counter supplement to treat diabetes.

For her work with the MRC, Dealtry has developed a mice model. "The mice are genetically-modified to become fat and develop diabetes. They are then treated with *Sutherlandia Frutescens* to see if it has an impact. Our initial results show that it is reducing the rate of weight gain. This may not directly help with established diabetes, but it will have supportive effects.

"We are also looking at the response of mice cells to *Sutherlandia Frutescens*

... There are biochemical reactions within insulin non-responsive cells, which we can reverse with the plant."

She and postgraduate student, Janet Adefuye, are also trying to determine the most effective way to take the medicinal plant – for instance, as a tea made with boiling water, cold water or mixed with ethanol or methanol.

"Thus far, boiling water seems to be the most effective way to take *Sutherlandia Frutescens*."

The student has been using the University of Fort Hare's Liquid Chromatogram Mass Spectroscopy (LCMS) instrument to analyse the compounds in the different extracts, using a process called Triple Time of Flight (Triple TOF).

"We have analysed these compounds against a database of known plant compounds and other anti-diabetic plant compounds. We have found that each extract might contain some compounds but not others." She presented her findings at the Society for Endocrinology, Metabolism and Diabetes of South Africa (SEMDSA) conference in April (2015).

Another of her students is trying to determine whether the plant has a greater effect when picked at different times of the year, while another is looking at how *Sutherlandia Frutescens* affects the immune system and whether it alters responses that would normally cause inflammation in cells.

"Part of what causes diabetes is an inflammation response in fat tissue. In this tissue, there are immuno-regulator cells, called macrophages, which control how other cells work, and determine if there is inflammation or not. If you don't get inflammation in the fat tissue, you may not develop diabetes."

Dealtry has published 35 journal articles.



HEALING GARDEN ...
Prof Maryna van de Venter (right), an associate professor in Biochemistry, has partnered with NMMU horticulturalist Elana Storm to set up a medicinal garden for traditional healers at NMMU's Missionvale Campus.

TESTING PLANTS THAT HEAL FROM NIGERIA, ROMANIA AND EGYPT

PROF Maryna van de Venter is testing the medicinal properties of plants from around the world, including Romania, Egypt and Nigeria, screening mainly for anti-diabetic, anti-cancer and anti-HIV/Aids activity – and yielding a number of positive results.

The C2-rated Associate Professor in Biochemistry has spent the last 15 years helping to take NMMU to the forefront of medicinal plant research in South Africa, particular in the complex field of anti-diabetic research, leading to her expertise being sought by universities across the globe. She has published 73 peer-reviewed journal articles.

"We have very good screening in vitro [in test tubes] for anti-diabetic activity. Diabetes is so complicated – but we've been optimising our system for 15 years. It's a good system." All her research is conducted in-vitro, and uses laser-based instruments to monitor the "mechanism of action" occurring in samples. She collaborates with a number of different researchers and departments, including pharmacy, microbiology and chemistry.

Lately, she has also been testing for "neuro protection activity" in plants, which could potentially be used in the fight against Alzheimers, Parkinsons, ALS [the acronym for Amyotrophic Lateral Sclerosis, or motor neuron disease] and other diseases affecting the brain. She is pioneering South African research into the medicinal qualities of mushrooms, which has been widely investigated in Europe and Asia and some countries in Africa, but not at all in South Africa.

Van de Venter also works closely with the country's traditional healers – and has been testing the medicinal properties of a number of plants used in traditional medicine. Partnering with Elana Storm, the horticulturalist responsible for NMMU's gardens, she has been instrumental in setting up a medicinal garden at NMMU's Missionvale Campus, where traditional healers can grow their own plants – and participate in regular workshops run by Van de Venter and her postgrad students (arranged via three national traditional healers' associations), to facilitate the sharing of information between researchers and healers.

"We work on plants that have been published in books already, as traditional healers won't tell you what they use. They have a belief that if they give their secrets away, they lose power.

"We have done a lot of work on the African potato, including testing the different species, as this is most commonly used in traditional medicine ... We have found that there are quite significant differences between the different species. People use the plant to treat cancer, but one species actually stimulated cancer cell growth ... The African potato's most well-known use is to boost the immune system – and it can definitely do the job." She shares her results at the workshops with healers. "We also try to explain our view of certain diseases, and the Western way of diagnosing and treating. Sometimes they will tell you how they diagnose and treat. It's a voluntary exchange of information."

Regarding her work on the plants of other countries, Van de Venter said: "We work a lot on Nigerian plants, in collaboration with the University of Lagos ... We have been looking at anti-cancer and anti-inflammation activities ... We have had quite a few plants that show good anti-cancer activity."

She has also tested a number of Romanian plants for anti-cancer activity, while the plants from Egypt have been tested for anti-diabetic activities. The research on the Egyptian and Nigerian plants has been funded by the African Laser Centre.

"We use a laser-based flow cytometer with two lasers ... Our facilities will be greatly enhanced by an NRF-funded widefield imaging cytometer [which arrived in 2015] which allows for the detection of up to 10 different parameters in a single cell."



GOLD TREATMENT ...
Prof Saartjie Roux and her students are investigating the use of gold to aid in the early detection of colon cancer.

COLON CANCER RESEARCH 'WORTH GOLD'

UNLIKE cervical, breast and prostate cancer – which can usually be picked up in the early stages through routine, simple screening processes – colon cancer is much harder to detect, which is why it is typically found too late. Scientists have also found that there is a strong link between colon cancer and the food we eat – or don't eat.

It is these two factors that are the driving force behind the pioneering research of NMMU physiology lecturer Prof Saartjie Roux who, together with her postgraduate students and a practising gastro-enterologist, is investigating novel diagnostic tools for early detection of colorectal cancer. They are specifically using gold nanoparticles, and are also paying close attention to how the right food can help prevent the disease.

These two focus areas fall under a much wider umbrella of research that looks at lifestyle-related diseases, brought on by what is known in medical circles as "metabolic syndrome", where people have a dysfunctional metabolism due to their diet and exercise choices.

"Metabolic syndrome is the world's biggest health problem, resulting in diseases that are growing much faster than what is predicted." Diseases brought on by metabolic syndrome include diabetes, obesity, cardiovascular illnesses and certain types of cancer, including colon cancer. It is estimated that a third of the adult population in the United States is affected by metabolic syndrome.

Commenting on her colorectal cancer research, Roux said: "The main problem with colon cancer is that people are diagnosed too late. If it is found in stage 1, there is a 90% chance that the person will survive beyond five years. If it is found in stage 4, this goes down to 8%."

Diagnostic tools for colorectal cancer, the third most common cancer, include a colonoscopy, but this is expensive and invasive, or faecal occult blood tests, which are not specific or sensitive enough. So this type of cancer is typically undetected until the cancer has progressed into a late stage of tumour growth. One of Roux's doctoral students, Lynn Cairncross, last year graduated with the new MSc degree in Nanoscience (Nanobiomedical Science).

This degree is co-driven by NMMU, the University of Johannesburg, the University of Free State and the University of the Western Cape. Cairncross investigated how tiny gold particles (nanoparticles) linked to certain peptides, target only colorectal cancer cell lines. She used the high resolution transmission electron microscopy (HRTEM) at NMMU for her research to gain more insight in the targeting process.

"We have equipment [worth R4-million, funded by the National Research Foundation and NMMU] to prepare the biological specimens for the HRTEM," said Roux.

"Lynn is now developing a rat model in which she can initiate colon cancer, and use the gold nanoparticles for early detection." Injected into the rat, the gold nanoparticles conjugated with biomarkers binding specifically to cancer cells. An external scan picking up where the gold is, could potentially pinpoint where the cancer is, making it easier to diagnose and to treat. "Nothing like this currently exists."

Roux also has a particular interest in how bacteria in the gut is affected by what people eat. "Most people with gut problems do not eat enough fibre [specifically, vegetables]. Healthy microbiota live on fibre and make short-chain fatty acids [especially butyrate], which protect the gut against inflammation and cancer. It is known that cancer develops more often in areas of the body where there is chronic inflammation."

For this research, along with the gold nanoparticle work, she has been working closely with practising gastro-enterologist and NMMU research associate, Dr Ernst Fredericks, who is passionate about seeing what can be done, in terms of our lifestyle choices, to prevent colon cancer.

Roux's research initially focused just on diabetes but soon spread to other lifestyle diseases. "My research does not focus on how to treat these diseases, but I have a passion to know how they develop. And by understanding the factors driving the disease, we can try to advise people about what needs to change."



PURIFYING METALS ...
Prof Zenixole Tshentu upgrades South Africa's precious metals through leading-edge purification processes.

GOLD ARVS – AND OTHER MEDICINAL METALS

ANTI-RETROVIRAL drugs made from gold? It's a possibility, says Prof Zenixole Tshentu, who has been using South Africa's abundant metals to formulate new drug compounds.

His pioneering research into the separation of metal ions is extending boundaries in terms of how these important elements can be used, including in the realm of medicine. Over the past few years, Tshentu and his postgraduate students have been focusing on gold anti-retrovirals and the use of vanadium to treat diabetes.

Essentially, the inorganic/analytical chemistry associate professor is "upgrading" the country's raw mineral resources by improving the methods used to purify them. In so doing, he is increasing their value.

Tshentu says the purification techniques used to upgrade these metals for new uses can be used just as effectively to recycle the precious metals found in discarded goods, such as those contained in the catalytic converters of cars (in exhaust systems), or inside discarded computer chips, referred to as e-waste.

"I call it urban mining. Our minerals underground are drying out – the platinum-group metals – yet the world is only recycling 17% of its precious mineral resources. These resources are not going to be around forever."

Tshentu, who has a C2-rating and 57 peer-reviewed articles, is at the early stages of setting up a focus area, which will look at "the urban mining of precious metals".

This innovative researcher chooses the "hydrometallurgical route" when it comes to purifying precious metals. This involves creating water-based chemical solutions, in which reagents (substances used in chemical reactions to selectively extract metal ions) are developed to target specifications. The chemical system is first modelled computationally.

"This allows us to pre-test the interactions that we think are critical to achieve selective separation." Once this is achieved, the functional chemistry is transferred onto a solid support Tshentu and his students typically use polymer nanofibre

materials as well as microspheres and silica particles) for ease of separation and to be environmentally friendly.

Tshentu said Lonmin, the world's third-largest platinum producer, had shown interest in NMMU's purification/separation technology, and was testing one resin that was developed by a PhD student.

In driving towards applications, Tshentu and his students have developed vanadium complexes that could be used as an alternative to chromium supplements (which are already on the market) to treat type 2 diabetes. "Vanadium inhibits one of the enzymes that hampers the internalisation of glucose within cells." Tshentu said though vanadium and chromium could both only be taken in very small quantities due to their toxicity levels, vanadium appeared to be more effective than chromium in the treatment of diabetes. He said only two vanadium compounds were currently being tested in clinical trials and there was more scope for further development.

In explaining his research on gold, Tshentu said platinum compounds were already on the market to treat cancer, through chemotherapy, and were now looking at using gold to treat HIV/Aids.

"What is being looked at is the effect of gold on HIV1 protease [one of the enzymes that is essential for the lifecycle of HIV]. Current drugs work on inhibiting the active site of protease thereby inhibiting the growth of the virus, whereas gold deforms the site by binding to selenium residues on the HIV protease."

Tshentu and one of his PhD students have constructed molecules with a dual effect, where both gold and its carrier ligand (a molecule attached to the gold atom) act separately but achieve a synergistic effect. "We've designed ligands that fit the active protease site, but we have bound them to gold with a low level of affinity so that the gold can break off and bind to the protein. The ligand would then go into the active site and inhibit the interaction of the protease with the natural substrate. We are still trying to prove this."

MARITIME / MARINE SECTOR

NMMU is striving to become a future African leader in maritime and marine sciences – a move that is being supported through strategic research initiatives.

UNIQUE PROJECT COULD SEE OCEAN ENERGY DRIVING DESALINATION PLANTS

RESearchers at Nelson Mandela Metropolitan University are pioneering an ocean energy project that could potentially use the motion of waves to drive desalination plants along South Africa's Wild Coast.

This would not only provide fresh water for communities in this region – which will become increasingly important with water demand in South Africa expected to exceed supply in the next five to 10 years – but would also allow for the development of agriculture and industry in this economically-depressed and under-developed area. Ocean energy could also be used to generate electricity, thus contributing to South Africa's strained energy supply.

The proposed project will initially focus on feasibility studies involving NMMU's Coastal and Marine Research (CMR) Unit, which will conduct environmental impact studies, as well as the University's Centre for Energy Research (CER).

The project's main focus areas include harvesting energy from deep ocean currents as well as wave energy, closer to the shoreline.

The up-and-down motion of waves can potentially be used to pump sea water, which can in turn be used for various uses, including driving osmotic desalination plants, propelling turbines to generate electricity or playing a role in aquaculture activities. New ocean energy harvesting devices, relating to these contexts, will be researched and developed.

Project coordinator Dr Freddie Vorster, a physics senior lecturer who is involved in a number of renewable energy projects at NMMU's CER, said the proposed desalination research project would be the first of its kind to be carried out by a South African university. The project team also includes NMMU's Research Chair in the Law of the Sea and Development in

Africa, occupied by Prof Patrick Vrancken, who is providing advice on the necessary legal requirements such a project would need to meet.

Vorster said the Renewable Energy Research Group headed by Prof Russell Phillips in NMMU's School of Engineering had already explored harvesting energy from ocean currents, using a unique segmented blade turbine patented at NMMU. "This turbine is capable of optimal energy extraction at varying rotational speeds and with varying ocean current speeds." He said further development of this turbine needed to be done, with larger prototypes culminating in ocean trials.

"One of the major offshore currents in the world is the Agulhas current off the South African east coast. It has good potential for energy harvesting due to its close proximity to the coastline in certain areas. However, performing trials

at sea would make such a project very expensive." He said it was likely that models simulating ocean current energy would be tested in the lab before ocean studies took place.

The project team hope to also investigate several other small scale ocean energy devices for electricity generation and desalination. Vorster said one of the important aims of this project was to build human capacity and expertise in ocean energy and in the maritime sector.

Last November saw the launch of the South African International Maritime Institute (SAIMI), based at NMMU, which is driving maritime research in this country.



RENEWABLE ENERGY RESEARCH ... Senior physics lecturer, Dr Freddie Vorster, from NMMU's Centre for Energy Research (CER), is coordinating NMMU's ocean energy project.



WILD WAVES ... NMMU researchers are looking at the possibility of using ocean current and wave energy along the Transkei coast to drive desalination plants.

STRATEGIC STEPS TO GROW AFRICA'S BLUE ECONOMY

MARINE law expert Prof Patrick Vrancken holds the continent's one and only Research Chair in the Law of the Sea and Development in Africa, which saw him playing a key role in the Marine Protection Services and Governance Lab of Operation Phakisa's Ocean Labs.

This government-led initiative saw the country's leading marine and maritime stakeholders, along with those departments responsible for delivery, brought together for an eight-week "think tank", where issues could be identified and solutions developed.

Part of the research carried out by Vrancken focuses, among others, on the comparison of legislation pertaining to Africa's marine environment. Unlike land, the sea is largely international territory, except for a few zones close to shore which fall under the full jurisdiction of national governments and other zones further away from the shore where they exercise limited jurisdiction. In the 1970s and 1980s, leading up to the adoption and coming into effect of the 1982 United Nations (UN) Convention on the Law of the Sea, marine law was heavily researched, but lost popularity as the world's focus shifted to other matters, like governance, climate change and terrorism. "There are very few researchers in this area left in this country or the rest of Africa," said Vrancken.

The result has been a lack of research and reflection on this branch of the law – which needs to be addressed and quickly, with African governments becoming increasingly involved in the oceanic environment. A poor regulatory environment for the management of oil resources, for example, could have devastating repercussions for a neighbouring country. Likewise, a country with inadequate legislation on fishing compared to its neighbour may find it more difficult to protect its living marine resources.

The 2050 Africa Integrated Maritime (AIM) Strategy, adopted by the African Union in January 2014, marked the start of Africa taking seriously its collective sea resources and maritime affairs – and the laws that are meant to protect and govern them.

But for the Strategy to function correctly – and lead to the growth of the maritime sector in South Africa and Africa – capacity still needs to be built in many spheres, including education, training and research, and a number of continental policies still need to be developed.

To do this, the South African government has established the South African International Maritime Institute (SAIMI), based at NMMU. Its launch in November 2014 was one of the highlights of the African Maritime Domain (AMD) conference, hosted by NMMU. The University has also launched Africa's first journal on the law of the sea – titled *iilwandle Zethu* ("Our seas"), the *Journal of Ocean Law and Governance in Africa (JOLGA)*.

The AMD conference brought together key decision makers from across South Africa, Africa and further afield. One of these was the United Nations Environment

Programme (UNEP), which is developing the African Ocean Governance policy. "The aim of the AMD conference was to contribute to the development of the AIM human resources development strategy and the various continental policies which need to complement the AIM strategy, as well as the current initiatives being taken in South Africa in those regards," said Vrancken, who chaired the AMD conference organising committee.

"The overarching vision of the AIM Strategy is to foster increased wealth creation from Africa's oceans and seas by developing a sustainable thriving blue economy in a secure and environmentally sustainable manner."



FOCUSED ON SEA LAW ... NMMU's Prof Patrick Vrancken – the incumbent of the South African Research Chair in the Law of the Sea and Development in Africa – headed up the organising committee for the African Maritime Domain (AMD) conference, the highlight of which was the launch of the South African International Maritime Institute (SAIMI).



BLUE BEGINNINGS ... NMMU Vice-Chancellor Prof Derrick Swartz (middle) unveils the plaque, heralding the new South African International Maritime Institute (SAIMI).

TACKLING LARGE-SCALE FISHERIES CRIME LED BY TRANSNATIONAL SYNDICATES

HIGHLY-ORGANISED, well-financed transnational criminal syndicates are involved in a complex web of fisheries crime: this can be defined as criminal activity linking illegal fishing with crimes such as tax evasion, human trafficking and fraud.

It is in part facilitated by the multi-national nature of the fisheries sector – for example, the ship's flag could be Liberian (meaning it falls under Liberian law), but the captain might be Greek, the crew made up of illegal migrants from the Philippines and the insurer British.

Vrancken said illegal fishing was not well policed or enforced via the existing system used to address Illegal Unregulated and Unreported (IUU) Fishing, through which fishing authorities check fishing vessels at sea and in port, as there are insufficient enforcement mechanisms within this system. In addition, related on-shore criminal activities go uninvestigated.

Broadening the view of illegal fishing to include fisheries crime and investigating the organised syndicates behind such activities forms the crux of a new approach, spearheaded by Interpol and Norway and with significant South African buy-in. This independent research and capacity-building network is called PescaDOLUS.

The new approach was the focus of an upcoming international conference to be co-organised by PescaDOLUS in South Africa in 2015. "PescaDOLUS's main focus is on innovative inter-disciplinary solutions addressing transnational organised fisheries crime. The network examines the criminal, legal and practical issues related to fighting such crime – and also creates a platform whereby the fisheries and enforcement authorities in different countries can talk to one another and share lessons learnt towards enhanced cooperation," said Vrancken, a member of the PescaDOLUS team.

According to Vrancken, it is very difficult for the authorities to find out what's happening out at sea and to take steps to address it – and it is also very expensive. It is complicated by the complexities of the legal regime governing the exercise of State authority at sea: What action can a country take? What can't they do, bearing in mind that illegal fishing is often complicated by other problems, including illegal migrants, unseaworthy vessels, drug trafficking and so on? A further complicating factor is the need for a wide range of agencies within countries and among countries to cooperate with each other.

In order to contribute to the work of PescaDOLUS, Vrancken is writing a book which will propose a new analytical framework to tackle issues of State jurisdiction at sea.



FISHING CRIME ... The Yu Feng, a Taiwanese flagged fishing vessel, is suspected of illegal fishing activity. (Source: www.businesskorea.co.kr)

UNIQUE EC ROCK POOL SYSTEMS COULD PROVIDE INSIGHT INTO 'ORIGINS OF LIFE'

It is not just children who are fascinated by the miniature ecosystems contained in coastal rock pools, but did you know that the rocky walls that form these pools are just as interesting? They grew through a bacteria-based process that – according to fossil records – dates back some 3,5 billion years.

Scientists have found rare living examples of these systems – regarded as the oldest type of biologically-mediated calcified formations on Earth – in certain areas of our globe today, including Shark Bay in Australia and the Exumas in the Bahamas. But they have been taken aback by the sheer number of such systems recently discovered south of Port Elizabeth in the Eastern Cape.

These colonies are giving scientists a glimpse into the hydrospheric (water) conditions that prevailed at the very onset of life on earth.

“They were the only living things in those days – they disappeared with the advent of other, more evolved organisms,” said B3-rated Prof Renzo Perissinotto, who holds a Research Chair in Shallow Water Ecosystems at NMMU and is part of a high-profile team – including two other South African Chairs and five international collaborators – which has been studying this phenomenon for the past year.

He explained that these bacteria-based formations – called living marine stromatolites – occur when freshwater seepage from the land comes together with seawater in the inter-tidal area, and cyanobacteria (blue-green algae), under certain conditions, play a role in depositing calcite crystals.

“Although other rare, isolated examples of similar formations have been reported to occur from Port Elizabeth to Tofu in Mozambique, the recent discovery of numerous and closely-spaced living stromatolites on the coastline south of Port Elizabeth appears to be extraordinary ... We have discovered about 200 actively-growing marine stromatolites from Cape Recife to Storms River. They are a unique feature and are very different to those found in Australia and the Bahamas.”

If you saw one today, you would be forgiven for thinking it was just a stagnant rock pool covered in a green carpet of algae – not realising that the same growth process that occurred billions of years ago was taking place right before your eyes.

“The process requires super-saturation of the water by calcium carbonate (CaCO₃), which only occurs in today’s marine environment under special conditions, for example, under states of hyper-salinity, excess evaporation or the mixing of extremely different water types.”

Isolated examples of stromatolites were first found in South Africa in the early 2000s in the Kei Mouth area. Perissinotto said the research team, which includes NMMU Research Chair in Earth Systems, Prof David Bell, and Rhodes University Research Chair in Marine Natural Products, Prof Rosemary Dorrington, along with staff, doctoral and post-doctoral students from NMMU’s Geoscience, Chemistry, Zoology and Botany departments, has conducted a year-long baseline survey relating to the structure, functioning and age of the stromatolites. He said the first paper about this, which was published in the South African Journal of Science, called for the government to protect these areas with special legislation, as is done in Australia.

“If we can prove that these structures are similar to the most ancient forms of life that have appeared on this planet, we have got a bit of the ‘origins of life’ story right here.” Perissinotto is also involved in a number of other research projects, the main one focusing on iSimangaliso Wetland Park, which includes Africa’s largest estuarine system (Lake St Lucia), about which he has published a book and more than 50 articles in international journals.

His research has contributed to the planned removal of “dredge spoil” islands, which were man-made from the 1960s to the 1990s to prevent the Mfolozi River from running into the St Lucia Estuary. “At the time, scientists wanted to keep the two separate as the silt levels were high in the Mfolozi and they thought it would have silted up St Lucia – but new scientific wisdom suggests the two should be allowed to ‘remarry’.”

This is largely due to the decrease of fish species and the general biodiversity of the system since their separation. Over 100 species of marine fish utilise St Lucia for breeding – these have decreased dramatically because St Lucia is currently a closed estuary [it does not flow into the sea]. “Through the Mfolozi connection, there will be more recruitment ... This is one of the most important [fish] recruitment areas on the African continent ... We are also discovering new species of invertebrates there all the time.”

Perissinotto is also conducting research on the biodiversity of surface and groundwater in the Karoo, as part of a natural baseline study by NMMU’s Africa Earth Observatory Network-Earth Stewardship Science Research Institute (AEON-ESSRI), which is being undertaken in anticipation of shale gas exploration in this area. “We are mapping 30 to 40 systems, ranging from large dams to small streams to temporary depressions ... We need to put their biodiversity on record before shale gas mining begins, so that we are able to monitor any significant changes that may occur.”

Perissinotto said he had thus far been surprised at the “incredible number of organisms” living in the waters of this semi-arid environment – which included the identification of at least one new species of copepod (a shrimp-like crustacean), similar to relatives found in the Fish River. “We have found buckets of shrimps ... It’s likely that they developed special adaptations to survive in this harsh environment.”

Perissinotto is also part of a team, led by the South African Institute of Aquatic Biodiversity (SAIAB), which is studying coastal micro-inlets (minor estuaries), which could possibly dry up in the next decade. “Forecasts predict that water demand will exceed supply by 2025 ... We don’t know the biodiversity of these inlets or the role they play in relation to the bigger estuaries.”



ROCKY RESEARCH ... Prof Renzo Perissinotto (right), who holds a Research Chair in Shallow Water Ecosystems at Nelson Mandela Metropolitan University, collects samples with students at rare living rock pool systems recently discovered in the Eastern Cape. Photograph: Lynette Clennell

INTEGRATED RESEARCH

NMMU is investigating critical issues affecting our planet through integrated research, which looks well beyond so-called silos of expertise to get the bigger picture, with the help of multiple disciplines and departments.

FRACKING IN FOCUS

FROM climate change to water security, politics to poverty, the Earth faces many existing and future challenges, none of which can be solved by individuals working in isolation.

All of these challenges are contentious. All of them raise debate, require focus, solutions to be sought and plenty of research. One that is a hot topic in South Africa is the potential exploitation of the Karoo for shale gas harvesting: To frack or not to frack – that is the question.

NMMU's Prof Maarten de Wit has defined a completely new field of trans-disciplinary research around the Earth's "commons" (shared resources) called Earth Stewardship Science. It links a range of existing disciplines from science to the humanities, to holistically tackle problems facing the planet, its commons, its people and all cohabitant species.

Researchers from a broad range of disciplines from across the country, the bulk of them postgraduate students, are pulled together under the umbrella of the Africa Earth Observatory Network – Earth Stewardship Science Research Institute (AEON-ESSRI), established by De Wit and his colleagues and based at NMMU.

The issue of hydraulic fracturing (better known as fracking) in the Karoo is high up on AEON-ESSRI's agenda. Government hopes to go ahead with fracking – as it ticks all the boxes in its National Development Plan, which has prioritised the need for economic growth to be linked to sustainable energy production, skills development and job creation – but have a signed an R18-million partnership agreement with NMMU for a three-year research project focusing on the consequences of shale gas exploitation in the Karoo.

The idea is to check whether it might be feasible and to determine what the potential for shale gas could be. But, more importantly than this, it is to conduct a baseline study of the Karoo, so that if the go ahead is given for gas extraction, and if things go wrong with surface water, air quality or the area's ecology, these matters can be taken to court.

"A baseline study enables the establishment of knowledge and relevant information on key attributes or characteristics of the situation prior to the commencement of prospective exploration/exploitation for shale gas in the Karoo, without which defence of potential litigation may prove almost impossible," said De Wit.

AEON-ESSRI – and the two, recently-merged "Big Science" projects that fall under it (Inkaba yeAfrika and !Khure Africa, which are both linked to the Department of Science and Technology's Grand Challenges Global Change Programme) – have a Karoo Shale Gas Group, headed by De Wit. Within this, there are 17 honours, MSc and PhD projects, and four more registered.

They range from studies on groundwater, vegetation and freshwater invertebrates to the political economy of shale gas development and how to engage local communities in scientific research.

"Shale gas resources represent a critically important transition fuel on the path to a decarbonised energy future. However, in the context of sustainable management of this relatively unconventional resource, and for the benefits of shale gas to be realised by all, it is essential that it is developed with effective safeguards to mitigate risks on a large number of complex interrelated issues linked to water resources, air quality, ecosystems and societal needs – shale gas may impact directly on them all."

De Wit said there was a five-year window of opportunity before the potential start of fracking, to gain a firm understanding of the natural underground water systems and surface environments, which could be used to establish a forensic baseline across the Karoo.

"Now is the time to work on these issues in order to avoid an adverse environmental legacy similar to that from abandoned mine discharges, which also affect food and health securities."

Much of the research on fracking was presented at the 10th Inkaba yeAfrica Scientific Conference, hosted by AEON-ESSRI, from September 29 to October 3 last year.

A mid-conference "shale gas day" was packed with students' presentations on baseline studies done thus far by NMMU's Karoo Shale Gas Group. There was also a shale gas field trip that saw the group visiting various research sites in the Karoo, including Tarkastad, Laingsburg, Oudtshoorn, Uniondale and Steytlerville.



ROCK ENERGY ...
Prof Maarten de Wit (right), who heads up MMU's Africa Earth Observatory Network – Earth Stewardship Science Research Institute (AEON-ESSRI), shows a sample of shale rock to Eastern Cape Economic Development, Environmental Affairs and Tourism MEC Mcebisi Jonas. AEON-ESSRI is conducting a baseline study of the Karoo, prior to the commencement of prospective exploration/exploitation for shale gas (through hydraulic fracturing or fracking).

US STUDENTS TACKLE EC WATER ISSUES

Water hazards in Nelson Mandela Bay's flood-prone Missionvale township were a key focus area for students from the Massachusetts Institute of Technology (MIT), working hand in hand with students from Nelson Mandela Metropolitan University, during a visit in March last year.



GLOBAL CONNECTIONS ... Students from NMMU Unathi Mdyogolo (left) and Soyama Ramncwana (third from left) teamed up with students from the Massachusetts Institute of Technology (MIT) (from left) Aurora Alvarez-Buylla, Libby Koolik, Josef Kolman and Laura Standley to come up with workable, sustainable solutions to Eastern Cape water problems.

Thirty students from the Massachusetts Institute of Technology (MIT) – one of the world's top-ranked universities – were in the Eastern Cape from 22 to 29 March 2014 to tackle "Global Water" issues with 30 students from NMMU.

The students – who were respectively from MIT's Terrascope and NMMU's Earth Stewardship Science programmes, both of which take a multi-disciplinary approach to solving real, complex problems affecting the Earth – homed in on township water hazards, focusing specifically on Missionvale township in Port Elizabeth. They also visited communities between Port Elizabeth and Mossel Bay.

"Missionvale flanks an inland 'bowl' – a natural old salt pan – which is prone to flooding," said Prof Maarten de Wit who, together with Prof Moutar Doucouré, heads up NMMU's Africa Earth Observatory Network – Earth Stewardship Science Research Institute (AEON-ESSRI) and was instrumental in organising MIT's visit. "There has been little thinking about long-term solutions to flood hazards, and there is no water or sanitation service in this area to speak of. With climate change, there will be a further increase in precipitation in this area."

Split into groups which included community members, the students explored on foot the informal settlements of Missionvale, Rolihlala, Soweto-on-Sea, Zwide and Veeplaas – and through the week brainstormed workable, sustainable solutions, taking into account municipal plans as well as engineering and socio-economic factors. "The MIT students were blown away by the dilapidated living conditions of the communities around NMMU's Missionvale Campus."

The students, who also travelled to NMMU's George campus, also attended talks and participated in public debates outlining South Africa's water issues and how these link to global water security, in the context of food security and land distribution for agriculture, climate change, mining and acid mine drainage, biofuels, water use and gas shale fracking, energy production, trans-boundary water issues, maintaining Africa's ecosystem services and more.

De Wit said one of the main aims of the trip had been to spark lifelong relationships between the American and South African students. "We want them to be talking to each other for the rest of their lives, and to focus on complex problems that their generations will be faced with over the next 10 to 50 years ... A year on, communication online among some of these students is alive and blossoming.

"The visit exposed MIT students and staff to issues of water security in Africa in general and South Africa in particular, and provided an opportunity for students from very different cultural and educational backgrounds to network and explore common ground to establish a basis for responsible earth stewardship."

MIT alumnus and Terrascope alumni mentor Johnny Yang said the value of the South African field trip was for the students to "see reality".

"They are trying to create solutions, but before they can create solutions, they need to understand the problem, and before they can understand the problem, they need to understand the people. Walking around the townships helped them to understand the people."

MIT student Catherine Yunis, 19, who is majoring in neuroscience and mechanical engineering, said she felt South Africa's water issues were "solvable – it's just a matter of time and resources".

"Change across generations is easier than in one generation, but I think it has to come from within [the community] for it to be sustainable."

Unathi Mdyogolo, 21, a second-year development studies student at NMMU, said the collaborative project was "exposing the Americans to some of the issues our country faces." The KwaMagxaki student said her eyes were also opened. "I saw how people were living, with some of the houses built in wet areas. I always knew there were problems, but it was different to see them for myself and speak to the people about some of the other problems."

NMMU CO-HOSTS SECOND DST/NRF GLOBAL CHANGE CONFERENCE

An impressive 234 research papers, covering 24 diverse themes, and showcasing the work of national researchers across a broad range of disciplines, were presented at the Second Department of Science and Technology/National Research Foundation (DST/NRF) Global Change Conference, held in Port Elizabeth in December 2014.

The event, which came two years after the First Global Change Conference, was jointly hosted by NMMU's Africa Earth Observatory Network – Earth Stewardship Science Research Institute (AEON-ESSRI) and the South African Global Change Science Committee. It was themed "Global Change Research in South Africa: Towards integration across disciplines, sectors and scales".

The Global Change programme was sparked by South Africa's Department of Science and Technology in 2008, when it launched its 10-year Innovation Plan for South Africa, called "Innovation towards a knowledge-based economy: 2008 to 2018". This plan identified five major challenges (termed "Grand Challenges") on which efforts needed to be focused to bring about social, economic, political, scientific and technological benefits. One of these related to global change with a focus on climate-linked changes on Earth – it is commonly known as the Global Change Grand Challenge (GCCG) programme.

The other four grand challenges are: The "farmer to pharma" value chain to strengthen the bio-economy; space science and technology; energy security; and human and social dynamics.

"Each of these grand challenges is designed to stimulate multidisciplinary thinking and to challenge the country's researchers to answer existing questions, increase interdisciplinary collaboration and develop new technologies," said AEON-ESSRI science director Prof Maarten de Wit.

Indeed, the main purpose of the Second Global Change Conference was to bring together the diverse global change research community in South Africa to enable them to share their research progress and outcomes across the broad scope of the GCCG programme – and also foster greater trans-disciplinary

and inter-institutional integration and collaboration. The 234 papers presented at the Second Global Change Conference were grouped under the following themes: poverty, agriculture, coastal, energy, carbon, education, mining, transformation, technology, remote sensing, conservation, climate, economics, alien species, urban sciences, modelling, ethics, geology, species, ocean, rural, monitoring, ecosystems, and social learning.

Inkaba yeAfrica and !Khure Africa, the two recently-merged "Big Science" projects that are managed under NMMU's AEON-ESSRI, have been increasingly linked to the GCCG programme.

The success of the DST's Global Change programme was analysed by a group of AEON-ESSRI students, for its effectiveness in stimulating trans-disciplinary research. A paper on their findings – called "Transdisciplinarity within South Africa's global change research: How (well?) are we doing?" – was recently published in the South African Journal of Science.

De Wit said: "It's worth pointing out that this critical examination as to how well the Department of Science and Technology (DST) is doing has been taken on board, despite the fact that the DST was taken aback by this very critical analysis."

From participating in global dinosaur debates to examining ancient landscapes at the place where modern humans are said to have evolved, NMMU's palaeosciences research has international impact.

STONE AGE PEOPLE GOT SMART IN SA

BEING able to use fire to engineer weapons out of stone, and perhaps even read the lunar cycles to know when the tides would be low enough to forage for shellfish, are some of the signs that Stone Age men and women first developed intelligence along South Africa's southern Cape coast.

An international, multi-disciplinary group of researchers has been collecting archaeological, botanical, geological, climate-related and other data in and around the Pinnacle Point caves near Mossel Bay, where it is believed that a small group of Homo sapiens survived an Ice Age between 195,000 and 123,000 years ago, and could very likely be the ancestors of everyone alive today.

What they have found has shifted the start of human cognitive development from some 20,000 to 30,000 years ago in France, a view long held in scientific literature, to 100,000 years earlier, in South Africa.

But what is also groundbreaking about the Pinnacle Point study – and likely to set a precedent for other major archaeological explorations – is that the research group is not just relying on its own limited understanding to tell the story about how things were. Instead, they are using state-of-the-art technology to recreate the palaeoscape (the ancient landscape), based on the archaeological artefacts they find, along with the flora and fauna in the area. They then create a model of the behaviour of Stone Age humans by “releasing” them as “agents” within this computerised landscape, checking how they may have gone about foraging for the available food resources. Finally, they test the predictions of the model against the archaeological data available.



HARD ROCK ... Stone tools found at the Pinnacle Point caves are evidence of Middle Stone Age human beings.

“We are using the agent-based model to develop hypotheses about how people would have reacted to resources, how they would have obtained them, the success rates of their hunting, how they would have moved around, how many people would have lived and foraged in a 10km radius, and the optimal group sizes for hunting,” said NMMU botany professor Richard Cowling, a co-principal investigator in the SACP4 project (the South African Coast Paleoclimate, Paleoenvironment, Paleoecology, and Paleoanthropology project), which is led by palaeoanthropologist Prof Curtis Marean, from the Institute of Human Origins at Arizona State University, and funded by the National Science Foundation (United States).

“This is a very different approach – and it is a world leader in that sense,” said Cowling, who has established a Centre for Coastal Palaeosciences at NMMU, linked to SACP4.

“What adds the gloss to this study is that we are looking at the dawn of our species. SACP4 is providing another layer of information, which makes the project [one] of global interest.” Already, a number of articles about SACP4 have been published in the world's leading science publications, among them *Science*, *Nature* and *Scientific American*.

Figuring out what resources were available – and how good people were at extracting these resources – is the first step towards determining how, when and why human beings started to advance cognitively.

STEEP CLIMB ... Many of the Pinnacle Point caves dot the steep sea cliffs around Mossel Bay. However, when these caves were inhabited by early human beings some 160 000 years ago, these caves were situated 5km to 10km away from the sea.

“With the evidence available today, one cannot refute that modern cognition emerged on the Cape South Coast ... You can observe more about modern human development here than anywhere else.”

Altogether, SACP4 has between 30 and 40 researchers from 20 universities from every continent, representing a huge range of disciplines, from archaeology to botany, geosciences, climate sciences, zoology, history and anthropology, who are “trying to put their little piece into the puzzle of building the palaeoscape”, said Cowling's co-worker Alastair Potts, a post-doctoral fellow in botany at NMMU, who is responsible for modelling vegetation for the recreated palaeoscape.

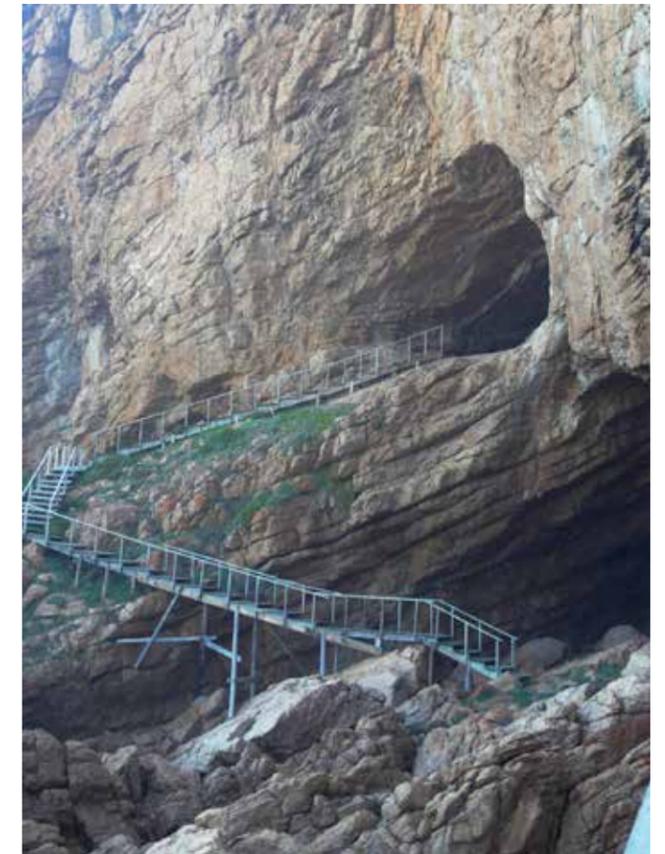
“We're at a juncture here. This project has brought together a whole bunch of different fields that are advanced enough to incorporate it all together to try and crack the nut of human cognitive evolution.”

The “agent-based foraging model” is based on the research of Arizona State University's Prof Kim Hill, an anthropologist, who used the model to map the movements of the Aché Indians in Paraguay, with 95% accuracy. Archaeological artefacts found through SACP4 have brought the dates of the earliest heat treatment for weapons from 20,000 years ago in France to 72,000 years ago at Pinnacle Point – where “bladelets” crafted out of silcrete rock have been found – although the heat treatment was used as far back as 164,000 years ago at this same site.

“Stone tools were the Swiss army knife of the Stone Age world,” said Potts. Cowling said the process of heating the stone to create the “bladelets” took several complicated steps – which involved “baking” the stone under sand – and Stone Age man by then would have had to have developed an effective way of communicating to enable them to achieve what was needed.

“Silcrete was their most important raw material. It enabled them to make these very fine bladelets and to have bows and arrows, with ridged arrow heads ... These tools would have been a major technological breakthrough.” Over the last decade, South African and other international researchers have also brought the dates of the earliest art works from 20,000 to 30,000 years ago in France, to as far back as 120,000 years ago in South Africa, and the time frames for the development of a true coastal lifestyle based on intertidal resources to about 110 000 years ago. Elsewhere, the coastal adaptation emerged only relatively recently, in the past 30 000 years or so.

Africa's southern Cape coast, with its prolific shell fish and edible plants, and its warm Agulhas current ensuring the coastline didn't ice up, would have been one of the few spots on Earth where humans could have survived at that time. NMMU PhD student Jan de Vynck, supervised by Hill and Cowling, has been looking at the high return rate of foraging in the inter-tidal zone. His masters



research examined the availability of bulbs in the area and found they were abundant just about all year round.

Potts said modelling the vegetation for the recreated palaeoscape was challenging “because you are dealing with an extinct ecosystem as the sea level has changed”. Sea has reclaimed a huge portion of land – leaving much of it under-water, thus SACP4 has required the assistance of off-shore marine geologist, Hayley Cawthra, to map the offshore geology, which has included extracting rocks from the seabed in deep, shark-infested waters.

De Vynck, Potts and another PhD student, Ramapulama Nkoana (who is working on climate modelling from the last glacial maximum, when large ice sheets covered parts of the earth, about 21,000 years ago), presented papers on their findings at a prestigious Society for American Archaeologists conference in April this year (2015).

“People have always known that Africa is special for its archaeology, but we never knew just how important it was,” said Potts.



DINOSAUR DEBATE ...

Acclaimed biologist and palaeontologist Prof Theagarten "Solly" Lingham-Soliar has written two books describing how and why creatures evolved – *The Vertebrate Integument* Volume 1 and Volume 2. He is a regular participant in dinosaur debates – with his articles featuring in leading science journals.

FEATHERS IN DINOSAURS - DOES THE THEORY REALLY FLY?

A South African scientist says the alleged feathers in a recently described Siberian dinosaur were not feathers at all, but rather the decayed support fibres of the skin.

NINETEEN years ago, the fossil of an apparently feathered dinosaur, *Sinosauropteryx*, was found in China, providing perhaps the most tangible evidence that birds were direct descendants of dinosaurs.

The idea itself was not new, dating back to Thomas Henry Huxley, an English biologist in the 1800s, and staunch supporter of Charles Darwin's theory of evolution.

A number of other allegedly feathered dinosaurs have since been found, including *Kulindadromeus*, which was found in Siberia, and named and described last year.

The "birds are dinosaurs" theory (BAD is the accepted acronym) proposes that birds are direct descendants of dinosaurs, in contrast to the theory that birds descended from an earlier archosaurian reptile, which gave rise to two separate lineages, one the dinosaurs and the other birds.

However, Prof Theagarten "Solly" Lingham-Soliar, a biologist-palaeontologist at NMMU in Port Elizabeth and concurrently an Honorary Professor in Life Sciences at the University of KwaZulu-Natal, believes conclusive evidence for protofeathers in dinosaurs has not been established. Instead, he says what appears to be protofeathers are in all probability collagen support fibres in, for example, a lizard-like crest extending along the head, neck, back and tail, and other external adornments such as lappets and frills, not to mention the skin itself.

Of deep concern to Lingham-Soliar is that "a pivotally important structure [the feather], with profound evolutionary ramifications, has been addressed with an almost complete disregard for scientific process".

What sets Lingham-Soliar apart from many others researching the ancient fossils of prehistoric creatures is that he also specialises in the biology and mechanics of living creatures, which includes expertise on the vertebrate integument – the outer covering of animals, including skin, hair, feathers and

scales – making it possible for him to critically cross-reference his research on fossils with living creatures.

"It is a source of constant wonderment to me that people lacking in this knowledge are engaged in the more critically-hampered task of describing mere traces of such soft tissue, that have incurred multiple transformations from their original state to that millions of years later."

Such faulty descriptions, he says, started 19 years ago when a photograph of the theropod dinosaur, *Sinosauropteryx*, was revealed to scientists in the United States (at the 1996 meeting of the Society of Vertebrate Paleontology at the American Museum of Natural History in New York).

"With no more than a superficial glance by palaeontologists at the somewhat sinuous structures along its back and tail, *Sinosauropteryx* made the front page of *The New York Times* as the first 'feathered' dinosaur – and two years later, this was endorsed in the prestigious journal, *Nature*, in which scientists interpreted simple filaments along the animal's back as primal feathers or protofeathers.

"If the filaments are genuine feathers, then *Sinosauropteryx's* importance can be understood for two reasons: first, it shows a primal stage of feather evolution and second, this occurred in an undoubted basal theropod dinosaur whereas, in other 'dinosaurs' found since with alleged feathers, there is a question-mark hanging over them: are they dinosaurs or flightless birds?" *Kulindadromeus* is the most recent dinosaur reported to have basal feathers. In July 2014, one of the leading scientific journals, *Science*, published an article on *Kulindadromeus* by Belgian palaeontologist Pascal Godefroit, of the Royal Belgian Institute of Natural Sciences, and his team of researchers. They dismiss any possibility of the integumental structures being collagen fibres and state that according to their findings, the integumental structures are basal feathers, including what they allege is a new evolutionary feather type.

Lingham-Soliar said technical flaws in the study led to his publishing a strong technical rebuttal in *Science* (October 2014). "In this latest instance, for ex-

ample, they get collagen fibre thickness wholly wrong by two orders of magnitude (a factor of 100) and crucially misinterpret collagen fibres as restricted to a cross-fibred architecture in vertebrates. This is not so but rather the latter is a specialist functional design. Collagen can, perhaps more frequently, form varied patterns, including random, for example, in human skin.

"This kind of fundamental lack of knowledge," says Lingham-Soliar, "has been responsible time and again for the same errors which BAD workers simply ignore despite the scientific rigour associated with the criticisms. Thus over the years, by simply ignoring the contradictory evidence, evermore instances of protofeathers are found, giving rise to the circular argument by BAD that because there are now so many examples of protofeathers in different dinosaurs they therefore must be genuine."

He goes on to say that *Godefroit et al* state that melanosomes [an organelle in animal cells, containing melanin, a light-absorbing pigment that scientists typically associate with mammals and bird feathers], found in *Sinosauropteryx* by Zhang and colleagues in 2010, is conclusive proof that birdlike feathers were found in theropod dinosaurs 50 million years before *Archaeopteryx*.

However, they ignore Lingham-Soliar's refutation of *Zhang et al's* study, in which he shows that while melanosomes are precise, ovoid to spherical cells, the alleged melanosomes in *Sinosauropteryx* were instead irregular, variously-sized structures that bore no resemblance to melanosomes at all and rather "were probably the debris of degrading filaments".

Furthermore, in a paper concurrent with *Zhang et al's* study, Lingham-Soliar showed that melanosomes were responsible for colour in the skin of the dinosaur, *Psittacosaurus*, which was covered in scales and not feathers hence, not restricted to mammals and birds. "Ironically, in a paper in *Nature* in 2014 by BAD workers, they found that the allegedly globular melanosomes found in *Sinosauropteryx* were not typical of feathers, as claimed by *Zhang et al*, but more characteristic of reptile skin."

In their reply to his paper in *Science*, Lingham-Soliar says Godefroit and his team go "from the frying pan into the fire" – when they describe an experiment in which they left a small bird submerged in water for six months and used a scanning electron microscope (SEM) photo to show the collagen was unrecognizably decomposed. He has responded briefly to their reply in his latest book, *The Vertebrate Integument, Volume 2*.

"An animal immersed in water for six months will of course rot – this is the exact opposite of the conditions that are required for the preservation of vertebrate soft tissue over millions of years. For preservation to stand even a small chance of success, when an animal dies, it would need to have been rapidly buried or dehydrated [the principle behind mummification] almost immediately, to slow down the decay of soft tissue, and then subsequently and quickly mineralised to ensure geological preservation – hence the rarity of preserved soft tissue in the fossil record. "This is standard text-book knowledge on taphonomy [the science of fossilisation]."

Lingham-Soliar further finds fault with their understanding of the anatomy of living animals. "They say that the ribbon-like structures they describe as a new feather type are highly unlikely to be collagen fibres associated with the tibia, as such fibres are normally associated with large muscles and that it is 'highly

unlikely that *Kulindadromeus* possessed similar particularly large muscles in the region of the tibia." However, a dissection by Lingham-Soliar of a 1.5 kg domestic chicken shows ribbon-like fibres in its tibia (Fig. 1). Responding on behalf of Godefroit and his team, co-author Dr Maria McNamara, a palaeobiologist at University College Cork in Ireland, said: "We would welcome further discussion of the ribbon-like structures in *Kulindadromeus*; to our knowledge an exact analogue does not exist in modern birds."

Responding to a query about the bird experiment, McNamara said: "The approach we used in our decay experiments is entirely consistent with previous studies, [which have] shown that many of the key processes and phenomena that control the quality of fossil preservation, especially the preservation of decay-prone soft tissues, can be simulated in the laboratory and occur within days to weeks of death. Our approach is thus entirely valid.

"We beg to differ with Prof Lingham-Soliar about the anatomy of collagen fibres in vertebrates, based on previous studies, plus our own studies of modern animals."

However, University of North Carolina's Prof Alan Feduccia backs up Lingham-Soliar's claims, calling the NMMU professor "the leading world expert on fossil collagen".

"Since the appearance of the first 'feathered' dinosaur in the *New York Times*, innumerable papers have appeared in prestigious journals reporting dinosaurs with varied forms of filamentous structures, all of which have been termed protofeathers. But, where is the scientific evidence, either structural or biological, that these structures have anything to do with feathers? Answer: there is none ... The 'evidence' for protofeathers has been extraordinarily bad ... To date, there are no examples of scientifically demonstrable protofeathers in any dinosaur, or for that matter any living or extinct bird."

Lingham-Soliar, a formerly British-based research chemist and later biologist, is a Fellow of the prestigious Linnean Society of London.

ENERGY SOLUTIONS

WITH fossil fuels polluting the air (and running out), the race for renewable energy is on – and NMMU is a keen participant.



100% ELECTRIC ... uYilo is pioneering e-vehicle technology in South Africa.

E-VEHICLE HUB AIMS TO CHANGE SA MOBILITY CULTURE

PICTURE the world 100 years from now. The population has grown from seven billion to about 12 billion and cities are bursting at their seams. Fossil fuels have run out and cars are powered by renewable energy. Because there is a limited number of cars city roads can accommodate, fleets of small e-cars are parked at solar-powered charging points throughout the city – available for short-term rent by the general public.

At the swipe of his metro card, a driver accesses a car. He drives it to the bus station, the mall or to work, where he parks it at a new charging point, and goes on his way. People still talk about the old days, when cities were half the size, and their great-grandparents owned bulky, noisy cars, which spewed out noxious gases. “Sounds unreal,” they say.

Sounds unreal to us today – but e-car sharing for urban mobility could well be tomorrow’s reality, as roads battle to cope with higher population densities. E-car sharing is already happening in major cities like London, Paris and Oslo and is a vision South Africa’s pioneering uYilo E-mobility Technology Innovation Programme is working towards.

uYilo is based at NMMU in Port Elizabeth – where students share e-bikes as they travel between the university’s north and south campuses. “People need to change to the concept of e-mobility as a service to get from North to South rather than the ‘I own the thing’ way of thinking. The e-bikes are a good way to showcase the sharing system ... Integrated with public transport, this is

the transport of the future for cities,” said uYilo deputy director Hiten Parmar.

“As shopping malls get bigger and bigger, it won’t be long before patrons park their car at one point, and then use an electric bike or vehicle to get around,” said Parmar. Because e-vehicles are clean, quiet and efficient for town driving, they are the obvious choice. Right now, the technology is very expensive because it is so new, but it will become cheaper as the industry grows.

uYilo was set up in Nelson Mandela Bay, the heart of South Africa’s automotive industry, by the government’s Technology Innovation Agency (TIA) in 2013. Before its establishment, the country had an electric vehicle programme aimed at building a local vehicle – the Joule – but due to the high costs of manufacturing in South Africa [about R9-billion to set up a motor manufacturing plant], the programme was discontinued.

In its place, uYilo was created, as a means of stimulating participation in the national and global e-vehicle industry, using the skills and capabilities that had already been developed, while also encouraging local manufacturers to compete with the original equipment manufacturers overseas. To stimulate public interest in e-mobility, uYilo, in partnership with Shamwari Game Reserve, Tracker, Imperial Green Mobility and the South African National Energy Development Institute (Sanedi), has imported a number of demo e-vehicles from the United States. These include large game viewing vehicles and several “micro-mobility” 4x4 vehicles, slightly bigger than golf carts, which are being

used in the fight against rhino poaching. The e-vehicles are all solar-powered. Additional “micro-mobility” e-vehicles have replaced the bakkies used by NMMU’s Technical Services department, “to test the value [they] can have as utility vehicles”. “As a society, we need to start driving smaller vehicles that are fit for purpose.”

uYilo has its own battery testing facility – the first step towards stimulating research in battery manufacturing for e-cars. “Batteries [lithium ion rather than the lead acid batteries of conventional cars] make up 30 to 60% of an e-vehicle’s weight, value and cost.” It’s an enormous sum of money, when you consider that the Nissan Leaf costs about R400 000 – and there remains uncertainty globally about how long electric batteries last.

“Even if South Africa doesn’t manufacture e-cars, we can still set up centres to manufacture batteries ... This will become more of a requirement with the newer fleets of hybridised e-cars,” said Parmar. These have both electric and

internal combustion engines, allowing drivers to fuel up when their charge runs out. uYilo is also creating an environment for the technological development of the “ecosystem” the electrical vehicle requires, such as charging networks, and the smart management of energy, especially in the context of load-shedding.

Parmar said uYilo was linked to several other universities, and the aim was to bring in as many external partners as possible. “University research coupled with industry leads and expertise can be converted into sustainable solutions to make a difference in the industry – and build the local economy.” uYilo also provides a neutral platform where car manufacturers can come together and have conversations with each other and government.



E-GAME VIEWING... uYilo E-mobility Technology Innovation Programme, based at NMMU, has partnered with Shamwari Game Reserve to test a large game viewing e-vehicle, which is solar-powered.



ANTI-POACHING ... These electric “micro-mobility” 4x4 vehicles are being used in the fight against rhino poaching at Shamwari.

GREEN ENERGY HIGH ON NMMU'S AGENDA

GREEN ENERGY HIGH ON NMMU'S AGENDA

WITH green energy a critical priority worldwide, NMMU is actively researching sustainable energy solutions, and also utilising the clean energy it generates, through grid-connected solar and wind energy. Its many major sustainable energy projects, most of them responding to industry needs, are highlighted below:

THE ESTABLISHMENT OF A PHOTOVOLTAIC TESTING LAB (PVTL)

The university's Centre for Energy Research (CER) has established a photovoltaic testing laboratory (PVTL) – one of just two in the country. As large solar farms pop up around the country, those who harvest sunlight are determined to ensure their photovoltaic modules (solar panels) are in tip-top condition for a maximum energy yield – and send the modules to the PVTL for testing.

“We recently tested our first big consignment of modules – 618 modules – and another 828 are expected,” said NMMU physics lecturer Dr Freddie Vorster. In addition to providing a much-needed specialised service to the local photovoltaic industry, the PVTL enables high-level training for students in a professional testing laboratory environment.

“The experience and knowledge gained from this test lab feeds directly back to our photovoltaics research activities which are primarily focused on the development of novel characterisation techniques.”

Vorster said one of the projects being developed in the PVTL was a “large area light-beam induced current mapping system”, which provides information on the electronic quality of a PV module. “It has the potential to become a standard technique for PV module testing.”

ELECTROLUMINESCENCE (EL) IMAGING EQUIPMENT ENABLES SOLAR PANEL TESTING IN THE FIELD

Among its vast array of cutting-edge equipment, the CER boasts the country's first outdoor electroluminescence (EL) imaging camera.

Solar plant operators typically send a representative sample of PV modules to a photovoltaic testing lab for testing to ensure they are functioning according to the manufacturers' specifications. With the outdoor EL imaging camera, one of the tests that could previously only be performed in a darkened laboratory environment can now be done in the field.

The EL camera captures images of light, not visible to the naked eye, that are emitted by the photovoltaic module to reveal material defects.

“It is the first time in South Africa that this can be done,” said Vorster. “The whole set up is completely mobile, and the testing is as accurate as you can get.”

In the past, EL tests could only measure one module at a time but, since the modules that are deployed in a solar farm are strung together, the newly-acquired equipment allows scientists to record module strings of up to 1000 volts at a time.

While EL testing does not form part of the three standard International Electrotechnical Commission (IEC) tests for photovoltaic modules, it is carried out by NMMU as a matter of course, adding an extra layer of information. Vorster said the camera package, developed in Germany, had won several innovation awards.

PHOTOVOLTAIC ENERGY YIELD STUDIES

The CER runs a PV module energy yield network, with the aim of monitoring the energy yield of both on-campus PV systems, as well as other PV modules in different climatic regions across the country.

The CER currently has six energy yield testing devices, monitoring 12 PV modules simultaneously. Data from the system is available online for researchers to access freely. Through this network, it is possible to monitor and compare the photovoltaic energy yield of a number of systems of various sizes and configurations, including off-grid remote applications and grid-connected systems. “Previously, it was difficult to directly compare data from many different PV modules ... With this system we can now also test the accuracy of standard models that predict energy yield from different PV technologies,” said Vorster.

PATENT FOR HYBRID CONCENTRATOR PHOTOVOLTAICS (CPV) SYSTEM

Even in cloudy weather when there is no direct sunlight, a unique CER-patented hybrid Concentrator Photovoltaics (CPV) system can still produce power. The hybrid CPV system makes use of both concentrator cells (onto which direct sunlight is concentrated using lenses) and conventional PV panels to capture diffuse light. The use of both concentrator and conventional cells – combined with solar tracking – results in a much higher energy yield than conventional flat plate PV systems.

DEVELOPMENT AND COMMERCIALISATION OF THE TWERLY™:

The Twerly™, an innovative “off-the-grid” street light that harvests both sun and wind energy, was commercialised in 2014. Harvesting both sources of energy ensures that it still comes on at night, even after days of rainy, sunless conditions – which is one of its main advantages.

The Twerly™ was conceptualised by NMMU mechanical engineering Associate Professor Russell Phillips, and developed by NMMU in collaboration with entrepreneur Nikolas Jankovich, with funding from the East London Industrial Development Zone. “In coastal cities particularly, it's beneficial to harvest both sun and wind energy,” said Phillips, who engineered the Twerly's vertical axis wind turbine (VAWT).

This works in tandem with a standard 140W photovoltaic solar panel to power a standard LED street light. Costing around R61 000, the outlay price is steep



SOLAR FARM ... NMMU is able to test solar panels in the field (as opposed to in the lab), using high tech electroluminescence imaging equipment.



INNOVATIVE THINKER ... Mechanical engineering PhD student Sean Poole is monitoring NMMU's new grid-linked wind turbine and looking for ways to improve its energy yield. As part of his doctoral research, Poole is working on a unique segmented blade turbine, which is undergoing testing.

– but less so when you consider it will provide free electricity for the next 30 years and there are no cables under the ground. “An ordinary electricity-powered street light costs about R30 000.”

The Twerly™ is also an “intelligent street light” – with embedded technology that can be linked to surveillance cameras and wifi hot spots. Controlled and monitored remotely, it can provide real time data on everything from battery life to renewable energy availability. Additional solar panels can also be added.

Phillips said the VAWT makes the turbine “totally quiet”, unlike its noisier horizontal propeller-type counterparts (like those used in wind farms), and better-suited for residential areas. It can also fit into the same space as an ordinary street light.

WIND TURBINE FEEDS NMMU GRID

The CER in 2014 tied a wind turbine to the university's power grid, piggy-backing on the linking of solar energy to the campus grid in 2013 – and is measuring how the yield of wind-produced electricity compares to the yield of sun energy.

But they say both are essential for optimal green energy results. “Because the wind doesn't blow every day and the sun doesn't shine during the night, renewable energy systems should be a hybrid of wind and solar to maximize energy yield,” said Phillips.

The R45,000 US-manufactured wind turbine is “state of the art in the way it controls itself”, said Phillips.



FUTURISTIC STREET LIGHT ... NMMU mechanical engineering Associate Professor Russell Phillips (second from left) with the team from NMMU's engineering technology institute eNtsa (from left) Riaan Opperman, Etienne Phillips and Akshay Lakhani, who all played a role in developing a unique wind and solar-powered street light, which is being commercialised as the Twerly™.

“Intelligence is built into the turbine. It's essentially a ‘plug and play’ – you plug it in and it takes control. Through a wireless link, it downloads data to a PC.” As part of his research, doctoral student Sean Poole is carefully monitoring how the new turbine does its job, and how it can be improved.

ARTS AND HUMANITIES

THE LINK BETWEEN ISIXHOSA AND AFRIKAANS

An isiXhosa professor's investigation into how his mother tongue has evolved has revealed unusual language links.

SOUTH Africa is a fragmented country. Apartheid put people in boxes – and while the barriers have been removed on paper, few people truly understand those with different cultures, and different languages, to their own.

“We were never allowed to know one another,” says NMMU's isiXhosa Professor Ncedile Saule (pronounced Sa-oo-le). Yet, his research is showing we could be more similar than we think.

Saule's studies into the origins of isiXhosa has revealed links with other languages – including KhoiSan and, unusually, Afrikaans. Saule picked up the connections between the languages by studying translated Portuguese history books, old diaries and letters, shut away in the archives of mainly Dutch libraries. “There are only pockets of information – it has not been easy to find.”

The catalyst for his initial research was requests for information from members of the isiXhosa community. “Many people want to find out about their history. There are missing links – people want to know what the Xhosa community was like before Europeans came to South Africa.”

His own surname – Saule – was likely a missionary's misspelling of Sawula, which he only discovered to be his true surname three years ago, shortly after his 114-year-old father passed away. “I want to look at the systems that created this confusion.” It is through this type of research that Saule has picked up the evolution of his mother tongue.

“There is so much of the KhoiSan language in IsiXhosa. It is embedded in the language – people don't even realise it's there. When the KhoiSan were defeated by the isiXhosa, they would become part of the isiXhosa clan, and the languages integrated.” He said isiXhosa names for certain rivers, mountains or areas were often adopted from the KhoiSan language. “For instance, the isiXhosa name for the Gamtoos river is Xelxwa while Qhagqiwa is used for the Swartkops River. Both are KhoiSan names.

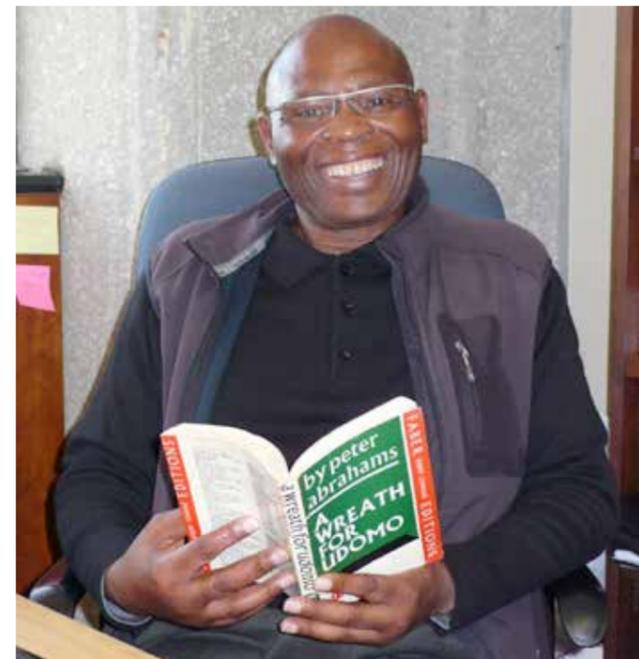
His search into the links between isiXhosa and Afrikaans was sparked by a phone call from Stellenbosch University Professor of Afrikaans and Dutch Johan Combrink (now deceased). “He said he wanted to believe there were more commonalities between Afrikaans and isiXhosa ... He said [those who speak the two languages] occupy the same land and breathe the same air ...

He said the two languages even shared similar origins: Afrikaans is a combination of various languages, as is isiXhosa.

“Before he said this, I wasn't interested in the relationship between Afrikaans and isiXhosa, but what I found was that there are more borrowings of isiXhosa from Afrikaans than any other language.”

Saule has a particular love for poetry – and has found similarities in the figurative language used by isiXhosa, KhoiSan and Afrikaans writers. “For instance, the language used to describe rain is similar in all three languages [they typically describe rain as a dancing woman]. They value rain in the same way ... Language carries culture and our value systems.”

When poet Antjie Krog wanted to translate poems in African languages into Afrikaans, Saule assisted by translating isiXhosa poems into English. “If you read the Afrikaans she made out of our translations – it's so beautiful. You would think they were not isiXhosa poems originally, but Afrikaans ones.” His other interest is indigenous knowledge systems – looking at food, plants and certain value systems. “Our people have lost a lot of this knowledge.” “I want to know how the traditional people interpreted the world.”



DEEP ROOTS OF LANGUAGE ... isiXhosa Professor Ncedile Saule's passion for researching how the isiXhosa language has evolved is yielding interesting results.

SOUTH AFRICA: 'A COUNTRY AT WAR WITH ITSELF'

Bottled-up history of 'hate and humiliation' driving SA's violent crime

In South Africa, you can get killed for a cell phone: What underlies the extraordinarily violent crime that is so rampant throughout this country?

“We are like a country at war with itself,” says NMMU Associate Professor and Head of Department of Political and Conflict Studies Lyn Snodgrass, who believes the high rates of violent crime stem from a deep emotional well, carried from one generation to the next, of feelings of humiliation and hate that have never been voiced or addressed – and that continue to bubble over, two decades into democracy.

“In 20 years, we haven't made much progress ... The government thought that with transformation, they could put in the structures and the people would follow, but they haven't dealt with the emotional baggage ... The only solution we have is through dialogue,” says Snodgrass, who marries her academic background in Psychology, Conflict Resolution and Politics in her trans-disciplinary research into deep-rooted, intractable conflict. She has published 15 peer-reviewed articles.

“I want to know how we manage violence in South Africa, and how we can stop the escalation of violence. We need to look at the emotion. [When we think of criminals], we think of the rational person, sitting there making rational decisions, but we are an emotional country.”

Snodgrass's research has led to her teaching conflict resolution and negotiation skills to peace-keepers in war-affected countries such as South Sudan and Ethiopia. She has also delivered papers on conflict processes at conferences in Kenya, Turkey, and Abu Dhabi (United Arab Emirates), and was part of a Summer Peace Academy in Germany.

Snodgrass said violence was influenced by factors such as poverty, patriarchy, inequality, stagnant economic growth, high rates of unemployment and low levels of education. “These factors also exist in other post-war and post-colonial African countries. But they don't have the same extraordinary violence for which South Africa is known ... What makes us especially violent? What is that aspect of apartheid [that has led to today's situation]? I tend to look at humiliation ... Apartheid was the ultimate humiliation.”

She said in South Africa, the so-called “born-frees” grow up hearing their parents' and their grandparents' stories – and it becomes their story. She said the Truth and Reconciliation Commission, at the time, was the best thing South

Africa had. “It was one of our finest hours – but there should have been an ongoing dialogue. The TRC didn't deal with humiliation.”

In the absence of meaningful dialogue, Snodgrass said South Africans had also learned that violence leads to results – thus just about all protest situations typically led to the destruction of public property. “This behaviour ... forces the government into dialogue and negotiation with communities. So, the violence becomes a learned response because it garners results

“For violent crime to be addressed, it needs to be approached from a position of emotional and spiritual intelligence ... We need a paradigm shift in this country.”



EMOTION BEHIND VIOLENCE ... Head of the Department of Political and Conflict Studies Prof Lyn Snodgrass is researching the role of past hurts in South Africa's violent crime.

DID YOU KNOW?

- Gun-related murders are the leading cause of violent death in South Africa, placing the country second in the world after the United States – an alarming position, when you consider that South Africa's population of nearly 52 million is less than a fifth of the United States' 322 million people.
- South Africa's homicide rates – 30 people per 100,000 people per year – are about four times the global average. According to the Geneva Declaration Secretariat, these homicide rates are indicative of a war zone or a country in crisis, struggling with stability.
- While there are no accurate statistics of gender-based violence, the Medical Research Council (MRC) estimates that three women are killed by an intimate partner every day.
- As much as 40% to 50% of women in the country have suffered intimate partner violence.
- The MRC estimates that only one in nine rapes are reported to the police. One in four men admit to raping a woman.

'BORN FREES': HOW THEY VIEW POLITICS AND RACE

HOW "free" are the so-called "born frees", really? How do they view themselves and those around them? What has shaped their political affiliation? Has South Africa's first post-democracy generation truly sloughed off the barbs of apartheid that still cling to their parents and grandparents?

To answer these questions, Associate Professor Joleen Steyn-Kotze, in the university's Department of Politics and Conflict Studies, is in the throes of carrying out a large-scale, long-term survey – the first of its kind – among "born-free" students at South African universities.

"There is very much a narrative that the 'born-frees' are post-apartheid critics, who are non-racial and who embrace democracy. This is not the case."

— Prof Joleen Steyn-Kotze

The study – a National Research Foundation (NRF) project, which is also funded by the Konrad-Adenauer-Stiftung (KAS) – began with a survey of students, at NMMU, Rhodes and Fort Hare University. It then moved to Stellenbosch, the Free State and the University of KwaZulu-Natal. And from 2016, Steyn-Kotze hopes to implement the survey at the universities of the Western Cape (UWC), Johannesburg (UJ) and North-West University.

For contrast purposes, the study is going to spill over into South African Development Community (SADC) countries and, ultimately, Latin America. "It's a 10-year project," said Steyn-Kotze, who has an NRF Y2-rating, and is President of the South African Association of Political Studies.

The idea behind profiling students is that they are the up-and-coming middle-class. They are affected by politics – but not swayed in the same way the very poor are. Nor are they indifferent to politics, as the elite tend to be, as long as their wealth remains unaffected.

"A key theme in democratisation is building a solid democratic middle-class ... The middle class tends to act as a buffer [between the poor, who are susceptible to radicals like the Economic Freedom Front (EFF), and the elite]. We want to know how students feel about the political system overall, who they vote for, and why? We also want to find out more about race relations. Do they like one another?"

What the study has revealed is that these students are "stuck between the political values of old and new". Apartheid's legacy is strong.

"There is very much a narrative that the 'born-frees' are post-apartheid critics, who are non-racial and who embrace democracy. This is not the case." The

students' answers to questions about perceived racism (in-group and inter-group racism) were revealing.

"Whites and coloured students will say there is in-group racism, while black students tend to say other groups are racist, but not their own."

Race, for some, is also a factor when it comes to voting. One student wrote: "ANC has made mistakes and [is] probably still making them but I'm afraid that if whites would take over apartheid will repeat itself which is why I stick to a non-white organisation – ANC."

She said one of the key stereotypes that had emerged in the study was that "all white people are rich and all black people are poor".

In a recent paper, Steyn-Kotze sums up the findings from the survey to date: "While students have ample opportunity to interact and integrate in a multi-racial setting, a continued racialised political cognition creates a fragile nationhood filled with contradictions. They are integrated, yet separated. They are united, yet unreconciled. They are free, yet oppressed. They are equal, yet unequal. They are non-racial; yet live a racist political reality."

Steyn-Kotze, a Y2-rated researcher, has written seven book chapters, 14 journal articles and presented 30 conference papers.



DIGGING DEEP ... Associate Professor in Political Studies, Joleen Steyn-Kotze, is investigating how South African students – the country's future middle class – feel about politics and race relations.

SOCIAL JUSTICE: WHERE DOES SA STAND?

A new BRICS study delves into issues of social justice in developing countries

THE idea of social justice is epitomised by South Africa's constitution – which calls for human dignity, equality, and freedom to participate in all of the political, socio-economic and cultural spheres of society. But is it actually being achieved?

Two decades into democracy, the country's economy has grown, but ordinary people are not richer. What has also grown is unemployment, service delivery backlogs and corruption – and, of course, the population.

Social justice is not just a concern in South Africa. BRICS Sociology (the acronym referring to Brazil, Russia, India, China and South Africa), a working group of sociologists from universities in the BRICS countries, is conducting a large-scale empirical study into the state of social justice in these five major developing countries – where 40% of the world's youth reside.

"The idea of political trust is essential to the idea of social justice. Are people trusting of the government?"

— Dr Jay Govender

"The study has currency globally, but particularly in the BRICS countries. We need to understand social justice within the frameworks of a country's historical context, political formation and its growth and development globally," says Nelson Mandela Metropolitan University's Dr Jay Govender, a lecturer and researcher in the Department of Sociology and Anthropology, who is leading the South African leg of this study.

It is the third of several BRICS projects – the first two being "Social stratification in BRIC countries" (conducted prior to South Africa's 2011 inclusion in BRICS) and the "Sociology of the youth in BRICS countries" (the results of which were published in December 2015). They are being carried out to create a comprehensive, comparative picture about society and the social problems faced in the BRICS countries, and will feed into a knowledge base termed "the Sociology of BRICS".

"The Sociology of BRICS will bring together shared knowledge and strengthen regional interventions for human development," said Govender. The social justice project is combining empirical findings with theoretical frameworks, backed up with available statistical data from the Human Sciences Research Council (HSRC), Statistics South Africa and elsewhere. "We want to use this project to say to government: this is the direction we think we should be going."

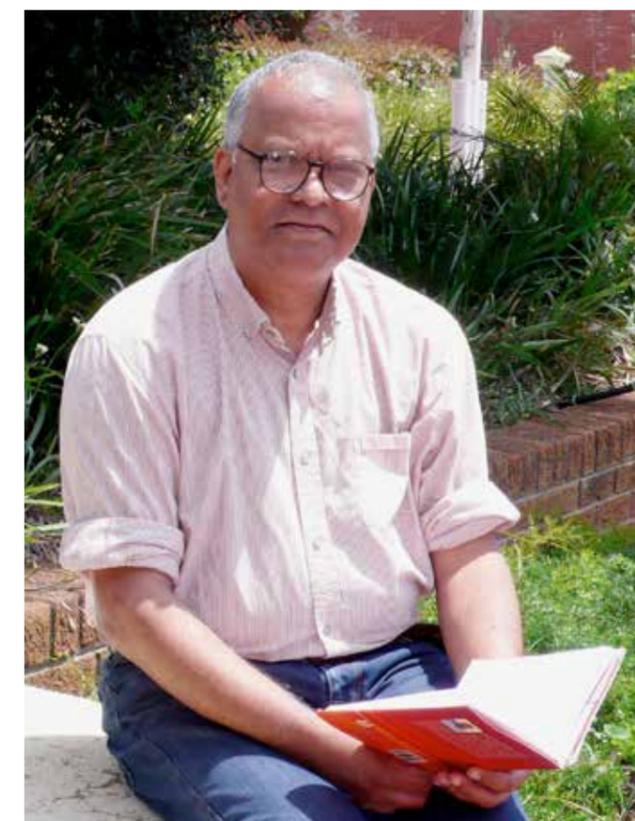
The South African report is being compiled by researchers from NMMU, the University of KwaZulu-Natal and North-West University. The empirical research aspect of the project will focus on five areas, namely the country's politics, where people live, their income (also addressing whether BBBEE

has worked), education (focusing on access to education and the success of the education system) and social problems (including inequality, poverty, and unemployment). "The idea of political trust is essential to the idea of social justice. Are people trusting of the government? What is the perception around government policies and programmes?"

In 2016, Govender will be leading a session on social justice and "the Sociology of BRICS" at the International Sociology Association's (ISA) Education Forum. He is hoping the Forum will raise young researchers from the BRICS countries, to continue research on the "sociology of youth" in these countries.

"We have similar problems: How do we charge programmatically towards addressing areas around the youth?" He said youth formed 74% of the global unemployed – a problem created and exacerbated by global inequality and capitalism, where a high concentration of the world's wealth was owned by a very few. "Wealth is produced not through activity but through investment instruments. There is no job creation ... with more and more young people finding themselves unemployed."

Govender has written one book, three book chapters and 11 peer-reviewed journal articles.



EYE ON SOCIETIES ... Dr Jay Govender is part of a team of BRICS (Brazil, Russia, India, China and South Africa) university researchers, investigating social structures and challenges in these countries.

CENTRES OF EXCELLENCE

NMMU/TELKOM CENTRE OF EXCELLENCE

TELECOMMUNICATIONS RESEARCH KEY THRUST OF NMMU/TELKOM CENTRE OF EXCELLENCE

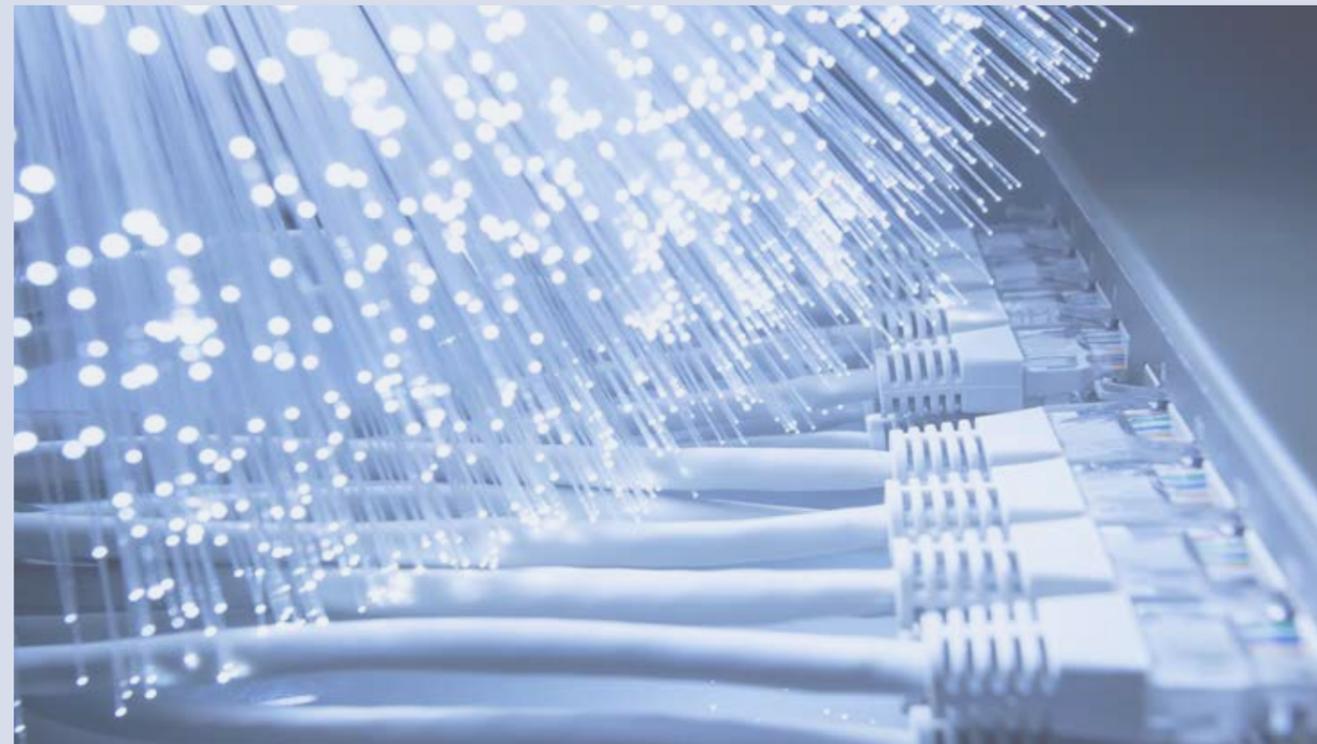
THE need for telecommunications research was the catalyst for the Centres of Excellence (CoE) programme, which was developed by Telkom South Africa.

The CoEs are scientific and engineering research entities at various South African universities, including NMMU. Each CoE consists of one or more units, each specialising in a particular research area.

The NMMU/Telkom CoE has three units:

1. The Distributed Multimedia Applications (DMA) Unit in the Department of Computing Sciences (led by Prof Janet Wesson)
2. The Optical Fibre Research (OFR) Unit in the Department of Physics (led by Prof Andrew Leitch)
3. The Photovoltaics (PV) Unit in the Department of Physics (led by Prof Ernest van Dyk)

These units are sponsored by Telkom, Ingoma Communication Services, Dimension Data, Dartcom, TMFC, the Technology and Human Resources for Industry Programme (THRIP), the National Laser Centre (NLC), the African Laser Centre (ALC) and Square Kilometer Array-South Africa (SKA-SA). This sponsorship has allowed for the purchasing of high tech equipment to be used for postgraduate research.



DISTRIBUTED MULTIMEDIA APPLICATIONS (DMA) UNIT

THE SHIFT TOWARDS 'UBIQUITOUS COMPUTING'

UBIQUITOUS computing (UbiComp) – a new genre of computing in which the computer completely permeates the life of the user – is the key focus area of the Distributed Multimedia Applications (DMA) Unit.

In the movement towards ubiquitous computing, computers become a helpful but invisible force, assisting the user in meeting his or her needs without getting in the way.

All models of UbiComp share a vision of small, inexpensive, robust, networked devices, distributed throughout everyday life and generally used for common-place purposes.

These computers should be able to accurately anticipate the user's needs and accommodate communication modes and styles. These devices are context aware, meaning they will be able to understand enough of a user's current situation to offer services, resources or information relevant to the user's particular context.

Contemporary devices that lend some support to this idea include mobile phones, digital audio players, radio-frequency identification tags, Global Positioning Systems (GPS) and interactive whiteboards.

Thirteen postgraduate students worked on UbiComp projects during 2014. Patrick Tchankue Sielinou completed his PhD studies on "a model for a mobile, context-aware in-car communication system to reduce driver distraction", while Simone Beets completed her PhD studies on "enhanced visualisation techniques to support ubiquitous access to personal information".

Master's student Michael Kyazze's project focused on "a hybrid model for managing personal health records in South Africa", while Cainos Mukandatsama's master's project was entitled "using a mobile pill reminder to support chronic disease management in South Africa".

The shift in focus to m-health initiatives has resulted in collaboration with other departments at NMMU, including the HIV Aids Unit and the Department of Biokinetics. It is also expected that this research will result in collaboration with local healthcare centres and providers.



PROF JANET WESSON ... Investigating mobile-linked computing.

OPTICAL FIBRE RESEARCH (OFR) UNIT

RESEARCH LINKED TO ONE OF THE "BIGGEST SCIENCE PROJECTS IN THE WORLD"

THE Optical Fibre Research (OFR) unit, which has research links to the Square Kilometer Array (SKA), was established in the Department of Physics in 2001, to study the optical characteristics of optical fibres and cables, with particular emphasis on the assessment and correction of polarization mode dispersion (PMD). This is the phenomenon whereby the two polarization states of a light wave are transmitted at different speeds through the fibre, limiting the transmission rates of optical networks. Since then the research interest of the unit has broadened to include long haul networks, fibre-to-the-home, and mega-science projects such as the SKA.

The unit's THRIP project on advanced optical fibre telecommunication technology, which finished in 2015, saw NMMU playing a vital role in creating South Africa's very first "National Measurement Standard for PMD". This project saw NMMU working closely with the National Measurement Institute of South Africa (NMISA). Over the past few years, NMMU has developed considerable insight into the measurement, compensation and emulation of PMD, and already holds a patent for one such device.

The focus on optical fibre communication research is critical, in the context of the telecommunication industry facing tremendous bandwidth demands from drivers beyond traditional Internet applications (such as email, Google, etc.) to include social and business networking, video and voice conferencing, 3G smart phones and cloud computing. In order to cope with these trends, fibre-to-the-home is now common in countries such as the United States, Sweden, Korea and the Netherlands. South Africa will need to follow suit if the country is to remain globally competitive.

The unit is also involved in research related to the SKA – said to be the largest radio telescope project in the world – which includes MeerKAT, the largest and most sensitive radio telescope in the southern hemisphere.

For this project, the unit's research areas include: technology evaluation for SKA, assisting with the design and testing of a "time and frequency reference subsystem" of MeerKAT, and Collaborative fieldwork.



NMMU is a member of the International SKA Signal and Data Transport (SADT) Consortium, led by Manchester University. Other members include the Council for Scientific and Industrial Research's (CSIR's) Meraka Institute, Tsinghua University (China), University of Western Australia, JIVE, ASTRON, NPL, SKA-SA and the Australian CSIRO.

PROF ANDREW LEITCH ... Head of the optical fibre research unit.

OTHER CENTRES:

NMMU'S OTHER RESEARCH CENTRES INCLUDE:

- Built Environment Research Centre (BERC), Faculty of EBEIT
- Centre for African Conservation Ecology (ACE), Faculty of Science
- Centre for Community Technologies (CCT), Faculty of EBEIT
- Centre for Energy Research (CER), Faculty of Science
- Centre for High Resolution Transmission Electron Microscopy (HRTEM), Faculty of Science
- Centre of Expertise in Forecasting (CEF), Faculty of Science
- NMMU-REDISA Centre for Rubber Science and Technology (CRST), Faculty of Science
- Centre for Research in Information and Cyber Security (CRICS), Faculty of EBEIT
- Centre for Coastal Palaeoscience (CCP), Faculty of Science

PHOTOVOLTAICS (PV) UNIT EXPLORING WIND AND SUN ENERGY

THE Photovoltaics Unit is running a number of research projects, including the new THRIP-funded "Renewable Energy Technologies for Application in a Remote Telecommunication Network".

The group's project objectives include: evaluating photovoltaic (PV) modules and small wind turbines, to determine their feasibility for deployment in the Telkom network; studying various aspects of PV module and small wind turbine energy system design and performance in order to enable industry partners to better utilise the resources available to them; developing human resources through the training of skilled graduates with expertise in the technical aspects of solar and wind energy; and further developing the capabilities of the photovoltaic and wind turbine research facilities within the Centre for Energy Research at NMMU, in order to benefit solar and wind renewable energy users in South Africa and Africa.

Research activities within the PV unit include the optical and electrical characterisation of Photovoltaic (PV) devices. Research themes include: Light Beam Induced Current (LBIC) mapping; Electroluminescence (EL) and Infrared (IR) imaging; and Current-Voltage (I-V) characterisation.

During 2014, the PV group established a Photovoltaic testing laboratory (PVTL).

NMMU'S TECHNOLOGY STATIONS

TECHNOLOGY STATIONS

NMMU has two technology Stations, funded by the Technology Innovation Agency (TIA). The first is eNtsa (previously the Automotive Components Technology Station), headed by Prof Danie Hattingh, and the second is InnoVenton, NMMU's Downstream Chemicals Technology Station, headed by Dr Gary Dugmore.

The aim of the Technology Station programme is to assist SMMEs to improve their competitiveness and innovation in a selected technical area. The two NMMU Technology Stations assist many SMMEs in the Port Elizabeth area.



PROF ERNEST VAN DYK ...
Head of the Centre for Energy Research.

RESEARCH CHAIRS AT NMMU

NMMU has the following research chairs, with their incumbents (as indicated):

- Chair in Nanophotonics, established under the South African Research Chairs Initiative (SARChI):
Prof JR Botha
- FirstRand Foundation South African Mathematics Education Chair (SARChI):
Prof Werner Olivier
- Chair in HIV/Aids Education, funded by the Faculty of Education:
Prof Naydene de Lange.
- GMSA Chair of Mechatronics in the Faculty of Engineering, the Built Environment and Information Technology (EBEIT):
Prof Igor Gorlach
- VWSA-DAAD International Chair in Automotive Engineering in EBEIT:
Prof Udo Becker
- Chair for Education in Human Settlements:
Prof Sijekula Mbanga
- Chair in Law of the Sea and Development in Africa (SARChI):
Prof Patrick Vrancken
- Chair in Shallow Water Ecosystems (SARChI):
Prof Renzo Perissinotto
- Chair in Microfluidic Bio/Chemical Processing (SARChI):
Prof Paul Watts
- Chair in Earth Systems Science (SARChI):
Prof David Bell

NMMU'S RESEARCH CAPACITY

DEVELOPMENT INITIATIVES

A CONCERTED EFFORT BY NMMU TO GROW ITS OWN TIMBER

THROUGH its Department of Research, Capacity and Development (RCD), NMMU offers a range of innovative programmes for staff to enhance their research skills and outputs.

One of these, run in partnership with SANTRUST, saw 20 academic staff members participating in last year's Doctoral Proposal Development Programme. Seventeen of the 20 have completed their research proposals.

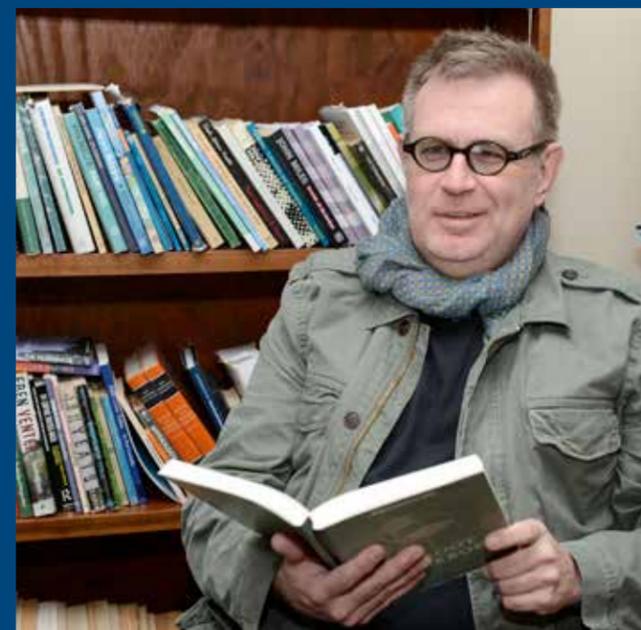
Academic staff members are also encouraged to participate in the "Strengthening Doctoral Supervision Programme", a joint initiative between a number of South African universities and Nuffic (a Netherlands-based funding agency).

In addition, ongoing strategic funding supports the internal Next Generation Initiative (NGI), through which NMMU identifies suitable PhD candidates in scarce skill disciplines and in areas where multiple retirements are expected within the next three to five years.

NMMU has also tapped into the New Generation of Academics Programme (NGAP), a national initiative driven by the Department of Higher Education and Training (DHET), which focuses on recruiting black women into the sector, to change the demographics and promote diversity in the DHET sector.

GOING PLACES — UP AND COMING RESEARCHERS AT NMMU

NMMU'S EMERGING RESEARCHERS SHARE THEIR MAIN RESEARCH INTERESTS — AND THE INSPIRATION BEHIND THEM.



CURIOS ABOUT LITERATURE ... Dr Marius Crous

ARTS — DR MARIUS CROUS

DR MARIUS Crous is a Senior Lecturer in the Department of Language and Literature. He teaches Afrikaans and Creative Writing. He has two doctorates — a D.Litt in Afrikaans from Stellenbosch University and a PhD in English from the University of Cape Town. He was the Faculty of Arts' Emerging Researcher of the Year for 2014. Crous has published three collections of poetry. In 2014, some of his poems, translated into English, were published in the anthology *In a Burning Sea* (2014).

What is your main area of research?

My emphasis is mostly on Afrikaans literature and poetry in particular, especially since I write poetry myself. I have an interest in contemporary literary theory, such as feminist literary theory, psychoanalysis and deconstruction, and I try and use it as a lens through which I read literature. My main focus is on issues of gender and identity politics and presently I am interested in queer theory [a set of ideas based around the notion that identities are not fixed and do not determine who we are; it rejects traditional categories of gender and sexuality] and queered readings of texts.

What drives you forward in your research?

Curiosity about new things to be discovered.



FOCUSED ON PROPERTY ECONOMICS ... Dr Michael Sale

ENGINEERING — DR NICKY MOSTERT-PHIPPS

DR NICKY Mostert-Phipps, who holds a PhD in Information Technology, is a senior lecturer in the Department of Information Technology, in the Faculty of Engineering, the Built Environment and Information Technology (EBEIT). She was the Faculty's Emerging Researcher of the Year for 2014. She has a National Research Foundation (NRF) Y2-rating, and is an NRF Thuthuka grant-holder. She is the Vice-President of the South African Health Informatics Association (SAHIA).

What is your main area of research?

My research area is health informatics [the use of technology in healthcare], specifically focusing on the role of Health Information Technologies (HITs) in improving continuity of care. Various electronic record systems such as Personal Health Records (PHRs) and Electronic Medical Records (EMRs) can play a significant role in improving continuity of care.

A PHR is a patient-oriented electronic record, usually web-based, that allows an individual to manage his own healthcare. The PHR is typically owned, created, and managed by the individual. It allows him to have a lifelong summary of all of his health information, gathered from many sources, in one convenient place, and is especially useful for individuals who manage chronic conditions such as diabetes and hypertension, or diseases such as cancer, tuberculosis, or HIV/AIDS. Once the National Health Insurance (NHI) is implemented in South Africa, primary healthcare services will be re-engineered to focus mainly on health promotion and preventative care. PHRs can play a significant role in achieving these goals by enabling patients to better manage their care.

An EMR is the electronic version of the paper medical record created in most healthcare settings. Inter-operable EMRs can exchange data with other EMRs, and PHRs, thereby supporting informational continuity of care. Despite well-re-

BUSINESS — DR MICHAEL SALE

DR MICHAEL Sale, who has a doctorate in Economics, is a lecturer in the Department of Economics. He was the Faculty of Business and Economics' Emerging Researcher of the Year for 2014.

What is your main area of research?

My research focuses on the economics of residential property valuation. More specifically, my focus is on economic techniques that are used to estimate monetary values for residential property characteristics, including characteristics that are non-market induced, for example, air pollution [e.g. houses situated near industry] or proximity to an airport. I find this area exciting as home ownership forms the basis of wealth for many individuals. The choices that are made in this segment of the market can reveal important policy issues, such as identifying appropriate areas for commercial land uses.

What drives you forward in your research?

I am inspired by finding solutions to the problems that society faces.



USING IT IN HEALTHCARE ... Dr Nicky Mostert-Phipps

searched benefits associated with the implementation and meaningful use of such electronic record systems, their adoption rate in South Africa is low. My research focuses on investigating barriers to adoption, as well as the suitability of currently available systems for the South African healthcare context.

What inspires you in your research?

I believe that, through my research contributions, I can play a role in improving the use of various HITs in the South African healthcare landscape, which can ultimately contribute to improved health outcomes..



DRIVING QUALITY PATIENT CARE ... Prof Portia Jordan

PROF PORTIA JORDAN

PROF Portia Jordan is an associate professor in the School of Clinical Care Sciences, in the Department of Nursing Sciences. She holds a Masters degree in Critical Care Nursing (2001), a Masters in Business Administration (2015) and a PhD in Nursing (2011). In 2014, she completed an 18-month lead researcher programme through the Plume Project, a collaborative initiative involving the Forum of University Nursing Deans in South Africa (FUNDISA) and the NRF, and was selected as a Plume Fellow.

The programme included 13 academics from various South African universities, who were chosen to develop a research programme and develop “grantmanship” and other research skills, to enhance the research profile of their respective nursing schools. She is an NRF Thuthuka grant-holder, and was the Faculty of Nursing Sciences’ Emerging Researcher of the Year for 2014.

What is your main area of research?

As a scholar, my research programme focuses on the implementation of clinical practice guidelines in high acuity [specialised] units, with specific reference to the care of mechanically-ventilated patient in critical care units.

This programme (which includes seven honours, five masters and one PhD student) will make a unique contribution to the body of knowledge and research pertaining to nursing practice, ultimately improving the quality of patient care rendered in high acuity and critical care units.

Evidence-based practice, based on research, is fundamental in providing quality patient care and should underpin clinical decisions.

What inspires you in your research?

Being able to maximise my potential and fulfil my purpose on Earth is what drives me to achieve success and excel to the best of my ability. It also inspires me to unlock potential in others ... The secret to success is hard work, commitment, passion, creativity and an absolute love for what you are doing.



BEACH AND TURTLE EXPERT... Prof Ronel Nel

SCIENCE – DR RONEL NEL

ZOODOLOGY Associate Professor Ronel Nel is a coastal ecologist, specialising in sandy beach ecology as well as sea turtle ecology and conservation. Since 2014, she has been an advisory committee member to the Indian Ocean South-East Asia Sea Turtle Memorandum of Understanding. She was selected as the Science Faculty’s 2014 Emerging Researcher of the Year.

What is your main area of research?

Beaches are highly valued and enjoyed environments, but typically disregarded as ecosystems. A large proportion of my research is to understand beaches as ecosystems – the patterns and processes that shape these systems, threats, and the options for conservation. South Africa is leading the field in terms of beach ecology research as well as the conservation of beach ecosystems, but there is growing pressure on these systems due to growing human populations, an increased demand for economic development (both of which encroach on the land space occupied by beaches) and climate change, which is resulting in sea level rise. In order to maintain pristine and socio-ecological [natural system with people] beach systems, we need to manage people and conserve beach habitats for all into the future.

What inspires you in your research?

Conservation – we need to protect species (like sea turtles) and habitats (like beaches) which always seem to be under-appreciated.

It is time for us to recognise and value both the direct and indirect benefits we receive from nature.



IDENTIFYING PATTERNS IN NATURE ... Dr Craig Tambling

DR CRAIG TAMBLING

DR CRAIG Tambling is a post-doctoral fellow in the Centre for African Conservation Ecology (ACE), situated in NMMU’s Department of Zoology. He works closely with a number of South African National Parks (SANParks) to conduct his research, including Addo Elephant, Mountain Zebra, Camdeboo and the Karoo National Parks. In September 2014, he chaired the local organising committee for the Southern African Wildlife Management Association’s (SAWMA’s) Annual Symposium, and was elected to SAWMA’s executive council.

What is your main area of research?

My current research focus is on predator-prey ecology with specific reference to the reintroduction of large mammalian predators [e.g. lions and cheetahs, brought into national parks in areas where they once lived, but were hunted out] and the impact that these predators have on trophic [food chain] interactions in African ecosystems.

This main focus can be broadly split into three components: The first is large predator feeding ecology [specifically lion, cheetah and spotted hyena], the second is predator-mediated behavioural responses of prey [notably buffalo and eland: how do they behave when large predators are reintroduced?] and the third is the interactions of meso-predators [middle predators, such as the black-backed jackal] with large predators. I am also involved in collaborative research with Stanford University, United States, where we are integrating field-based monitoring techniques with sophisticated airborne vegetation mapping techniques, to further understand the hunting behaviour of lions and prey responses to the presence of lions.

What drives you forward in your research?

I’m driven by the ongoing quest to understand how nature works and what drives the patterns that we observe in nature. In addition, I believe that the conservation of natural resources requires a fundamental knowledge base on which sound decisions can be made – my goal is to provide this fundamental information.



FOCUSING ON THE STORIES OF WOMEN IN EXILE ... Dr Marisa Botha

DR MARISA BOTHA

DR MARISA Botha, who has a D.Litt. degree, is a postdoctoral research fellow in the Department of Language and Literature. She is an African Humanities Programme Fellow, funded by the American Council of Learned Societies in partnership with the Carnegie Corporation of New York. This year, she has been selected, as one of 25 women researchers under the age of 40, to feature in the book, *Emerging Female Scientists in South Africa*, which will be published in May 2016.

What is your main area of research?

My research focuses on South African women’s prison and exile “life narratives”. The chosen autobiographies, which are in the form of journals and prose, emphasize trauma sustained during South Africa’s tumultuous political history. They reflect the historical moment in which they were written and illuminate the concepts of intersubjective and collective memory [both concepts relate to shared memory] in the formation of a cultural identity.

The research is of importance because it investigates questions of memory, trauma, culture and gender as represented in politically inflicted trauma life narratives. The study centres on South African women’s life narratives as opposed to the majority of studies which focus almost exclusively on South African men’s prison and exile life narratives.

What drives you forward in your research?

As most researchers, I am driven by curiosity, to find answers to questions in gaps of knowledge. Whenever my enthusiasm wanes, I remember the words of John Kehoe: “The greater my success, the greater my ability to help others.” This reminds me that people are interconnected and that one person’s success is beneficial to many.



ECOLOGY OF AQUATIC INVERTEBRATES ... Dr Nelson Miranda

DR NELSON MIRANDA

DR NELSON Miranda, a post-doctoral fellow working under the Department of Science and Technology / National Research Foundation (DST/NRF) Research Chair in Shallow Water Ecosystems (held by Prof Renzo Perissinotto at NMMU), is an aquatic invertebrate ecologist with research experience in freshwater and estuarine environments. He holds a PhD in biology and has over 20 publications in peer-reviewed scientific literature, including high impact international journals such as *Diversity & Distributions*, *PLoS ONE*, *Estuarine, Coastal and Shelf Science*. He received the 2014 award for “best young researcher paper” in *Molluscan Research*, the journal of the *Malacological Society of Australasia* and the *Society for the Study of Molluscan Diversity*.

What is your main area of research?

My research aims to review, update and generate scientific knowledge about the diversity, taxonomy [classification] and ecology of aquatic invertebrates [i.e. crustaceans, molluscs and worms that live in water] in South Africa. Continuous research into the state of biodiversity and alien invasive species is of critical importance, in line with national priorities of water quality and water security and particularly for the conservation of protected areas in shallow water ecosystems. This involves empirical approaches, using cutting-edge equipment and novel techniques, to address the ecological effects of factors such as eutrophication [i.e. when aquatic systems have an over-abundance of nutrients, frequently due to run-off from the land, and often caused by human activity], alien species invasion and changes in land-use and climate. Species are the building blocks of ecosystems and it is crucial that they are correctly identified and described, particularly in this ‘era of biodiversity’.

What inspires you in your research?

High quality work, dedication and a passion for learning.



ANALYSING CONSUMER TRENDS IN INDIGENOUS FOOD MARKETS ... Dr Louis Njomo

DR LOUIS NJOMO

DR LOUIS Njomo, who has a DTech degree in Marketing Management, is a postdoctoral fellow at NMMU’s Business School. His research focuses on informal markets relating to Sub-Saharan African immigrants in South Africa. Njomo himself is an immigrant from Cameroon.

What is your main area of research?

My research focuses on immigrant markets – specifically, the indigenous (non-local) food market in South Africa. Despite the ever-growing number of Sub-Saharan African immigrants in South Africa, immigrant consumer behaviour – in the context of indigenous food – is perceived as strange within the broader South African food market. Thus, most supermarkets do not cater for the Sub-Saharan African immigrant market. One of the aims of my research has been to establish a food consumption behaviour model of Sub-Saharan immigrants to enable leading supermarket chains to cater for indigenous food needs. South Africa’s leading supermarket chains have acknowledged the growing potential of the emerging immigrant market and are interested in catering for their culinary needs. However, these chains lack the understanding and knowledge of the market.

In my research, I have looked at the consumer behaviour of both buyers and sellers of indigenous food (e.g. how much indigenous food do immigrants buy, where do they buy it, their monthly spend on indigenous food, their preferred indigenous foods, the factors that influence whether they buy indigenous or local food, etc.), as well as entrepreneurship (e.g. ethnic restaurants and shops that sell indigenous food), specifically exploring the challenges faced by ethnic entrepreneurs in the indigenous food industry.

A second research focus is on subsistence markets. Subsistence consumers (buyers and sellers) are the very poor in society, those who basically struggle to survive (e.g. by selling small amounts of crops they cultivate themselves). I look at how they make decisions on the goods and services they buy or sell and am currently working on a study conducted in rural India (together with Prof Steve Burgess, who heads up NMMU’s Business School).

What drives you forward in your research?

The fact that I am passionate about what I do – teaching, researching, supervising and assisting students with their treatises. I particularly enjoy the research assistance I give to MBA students.



REFINING FUEL ... Dr Adeniyi Sunday Ogunlaja

DR ADENIYI SUNDAY OGUNLAJA

DR ADENIYI Sunday Ogunlaja is a post-doctoral research fellow in the Chemistry Department, working under Prof Zenixole Tshentu, an associate professor in inorganic/analytical chemistry. Ogunlaja holds a PhD in Chemistry. Last year, he received the 2013 Sasol Post-Graduate Medal of the South African Chemical Institute, awarded annually to innovative young chemists. In 2012, he was awarded a travel grant from prestigious international science journal Nature to attend the Gordon Research Conference in the United States.

What is your main area of research?

My research focus is in catalysis [the increase in the rate of a chemical reaction due to the addition of a catalyst] and fuel refinement (desulfurization and denitrogenation). This research is critical for South Africa’s economy, especially considering the legislative issues around fossil fuel processing and the prospects of South Africa expanding the exploitation of oil reserves (and shale gas).

Hydro-desulfurization (HDS) and -denitrogenation (HDN) of fuel oils are essential processes employed in petroleum refineries to eliminate organosulfur and nitrogenated compounds (which emit harmful nitrogen- and sulphur-oxides to the environment when combusted) in fossil fuels in order to meet the increasingly strict regulations mandated by environmental protection agencies: Sulfur should be less than 10 parts per million (ppm) and nitrogen less than 1 ppm.

Current processes employed for HDS and HDN are limited (sulfur content in fuels has only been reduced to 200 to 500 ppm) and high amounts of harmful emissions continue to affect the environment.

Motivated by this and other environmental concerns, petroleum industries are considering other carbon sources for the production of fuels. The use of biomass and algae resources as an alternative source of fuel has been found to be a potential source of food insecurity and the total production of fuel from these sources could not meet the ever rising global energy demand. Hence, the need for the use of a much cleaner conventional fossil fuel is required.

We have developed an oxidative desulfurization (ODS) process which is a complementary step to the HDS process in order to meet the mandated environmental protection agency limit. The sulfur in hydro-treated diesel after the oxidation/adsorption method fell below 2.4 ppm.

We are currently improving the ODS oxidation catalyst and also working on an adsorptive denitrogenation process.

What drives you forward in your research?

My inspiration comes from chemistry, hard work and the desire to protect the environment from noxious gases emitted during fuel combustion (carbon-, nitrogen- and sulphur-oxides). The desire to design new chemical processes that are beneficial to the fuel refining industries as well as society at large has motivated me to go above and beyond in exploring possible ways of producing cleaner energy from fossil fuel.

I would say that the secret of success is consistency of purpose. If you have the will to win, you have achieved half your success.

INNOVATION & ENGAGEMENT

INTELLECTUAL PROPERTY AND THE COMMERCIALISATION OF RESEARCH

DURING 2014, NMMU filed two provisional patent applications, along with six South African patent applications and two patent cooperation treaty applications. Five design applications were also filed, as a way of broadening the university's protection of intellectual property.

NMMU continues to be involved in a number of companies that were created to commercialise the university's intellectual property.

One with strong sales locally and in Europe relates to NMMU's rose preservation technology, which has been commercialised through **African Floralush (Pty) Ltd**. The supply of roses in South Africa has become a challenge, which may lead to the relocation of the business.

The commercialisation of a **novel rubber chemical** through Rubber Nano Products (Pty) Ltd received a boost with support from the Technology Innovation Agency (TIA) for technical development, which has led to significant progress being made.

A license agreement for the commercialisation of an **off-the-grid street light** (the Twerly) was signed in 2014 by Innovolve, NMMU's wholly-owned commercialisation company.

Getting closer to commercialisation are two major TIA-funded projects, one focused on microalgae-to-energy technology and the other on welding technology. A commercial feasibility study showed that the microalgae project was feasible at a one hectare scale and a proposal for construction has been favourably considered by the Department of Science and Technology.

A micro-demonstration plant is being constructed at NMMU, before the larger plant is built. A business plan for the welding technology has been submitted to the Industrial Development Corporation and venture capital funding is being negotiated.

NMMU also has a number of smaller projects that could potentially change the quality of life of people. These include a unique call button for disabled people, a maths and science tablet-based video series, career exploration tools for primary school children, and contact lenses for non-Caucasian corneal profiles.

NMMU'S CONTRIBUTION TO PROVINCIAL INNOVATION-PROPELLA

IN 2014, NMMU received approval for funding worth R7 million from the Industrial Development Corporation, to establish an advanced manufacturing incubator in Port Elizabeth.

Launched in May 2015, the incubator, called Propella, is supporting the establishment of high-potential businesses from NMMU and elsewhere in the city. The university and various private sector partners have provided funding.

NMMU still champions the Regional Innovation Forum (RIF) that brings together stakeholders from academia, industry and government to provide a voice for innovation in the region.

The RIF has strong ties with the local Business Chamber and is currently driving a number of projects to increase the links between academia and business and to increase business innovation. These include an industry-university meeting day, the development of a "decision tree" for funding and the provision of reviewing services for proposals.



KEY INNOVATION & ENGAGEMENT PROJECTS



TURNING ALGAE INTO ENERGY ... Prof Ben Zeelie inspects NMMU's recently-rebuilt algae production plant.

GLOBAL BIG GUNS EYE GREEN COAL PROJECT

A GREEN coal project spearheaded by NMMU has captured the attention of the International Energy Agency and some major coal producing companies nationally and internationally.

As NMMU's internationally-recognised chemistry institute InnoVenton gears up for phase one of its R114-million algae-to-energy technical demonstration project, which will be based in Mpumalanga, international interest is flooding in – including discussions regarding the possible construction of similar demonstration plants in China and the United States.

The South African pilot will have two major green components: the mitigation of harmful carbon dioxide from factory flue gas, which will be used to grow the algae, and the harvesting of the algal biomass, and its subsequent binding with otherwise-wasted coal dust to form coal briquettes known as Coalgae®. Each year, South Africa's mines produce about 70-million tons of coal waste, mainly in the form of very fine coal dust. The estimated stockpile of discarded coal in South Africa is estimated at over 2,5-billion tons – enough to run ten 1000MW power stations for more than 100 years, if it can be recovered and used.

Alternatively, Coalgae® may be used to produce a bio-fossil crude oil and a solid coal residue which is virtually smokeless when it burns, with significantly reduced greenhouse gas emissions. The amount of bio-fossil crude oil that can be produced from Coalgae® (assuming only waste coal is used for this purpose) can be as much as 40% of South Africa's annual oil imports.

Innoventon's Prof Ben Zeelie said the Department of Science and Technology had in principle approved the funding for the large-scale one-hectare pilot fa-

cility. But before this can commence, a smaller-scale model is being tested at InnoVenton's algae production plant in Port Elizabeth. "We have to produce 10 tons of product, which will be sent internationally for testing. Some tests will also be carried out with Eskom, for their purposes." The on-campus plant is being rebuilt for extra efficiency – and Zeelie is confident it will take just two months to produce the required 10 tons.

Coalgae samples will be sent to Washing University in Missouri, where it will be tested by a consortium for clean coal combustion. InnoVenton is also planning to send samples to VTT Technical Research Centre of Finland, which will carry out both tests on the production of bio-fossil crude oil from Coalgae® as well as characterisation of the oil for refining purposes. Finally, Siemens in Germany will be approached regarding the testing of Coalgae® as fuel for gasification.

"Gasification is a different way of using the coal. Instead of burning the coal directly, you make a gas from it – a mixture of hydrogen and carbon monoxide – and then use the gas to run a turbine (it burns like petrol). The level of energy efficiency is much higher than burning coal. For instance, Eskom runs at approximately 30% efficiency, while energy generation via gasification can achieve efficiencies between 55 and 65%. I am hoping that the additional hydrogen in the biomass will give Coalgae® an advantage over normal coal as gasification fuel."



WOMEN'S RIGHTS ... During a visit to South Sudan, NMMU's David Abrahams (middle) spoke to local women about the absence of legislation protecting women in that country.

INTRODUCING LADY JUSTICE TO WOMEN IN SOUTH SUDAN

In a country where rape survivors are often forced to marry their attackers, to avoid the stigma attached to rape, it is clear that justice is askew.

"There is a dire need for legislative reform in South Sudan," said Nelson Mandela Metropolitan University (NMMU) law lecturer David Abrahams, whose extensive research has found there is almost no legislation that protects women from sexual violence in this, the world's newest country.

He has found that where a rapist is prosecuted, he may face short-term imprisonment. However, it may be shown that the alleged victim was of immoral character – and she may find herself charged with adultery and facing imprisonment.

Victims of war-time rape remain completely unprotected, but provisions are in place to protect members of armed forces who commit these crimes. Abrahams, an expert in international humanitarian law pertaining to war, is hoping his work – the subject of an article published in 2014 in the national law journal *Obiter*, and personally mailed to some of South Sudan's lawmakers – will lead to stronger protection for women.

Abrahams spent two weeks in Juba, South Sudan's capital, in November 2013, teaching international law and international humanitarian law to members of the South Sudanese government, through the South Sudan Executive Leadership Programme (SSELP), a post-conflict leadership and training programme pioneered by NMMU's Business School.

While there, informal conversations he had with the local people revealed an almost complete lack of women's rights, particularly when it came to sexual violence. He confirmed this through far-reaching research into all the different aspects of law applicable in South Sudan, which includes customary law (relating to tribal customs) and statutory law (domestic court law) as well as the country's interim constitution, and decided to publish a paper, in the hopes that it would lead to reform.

"South Sudan is in the process of reforming laws, but this is taking place very slowly." Progress is also hampered by the current wave of violence. 2005 saw the end of 21 years of civil war between what was then southern Sudan and

northern Sudan. A peace agreement was signed in 2005, and South Sudan went on to gain independence in 2011. But peace was short-lived: In December 2013, fresh fighting within the new country began, sparked by tribal differences within the fledgling government, and it continues today.

Abrahams said South Sudan had embarked on developing a National Action Plan pertaining to women. However, the country faced a number of challenges, including the lack of gender-based violence laws at national and state levels, and an ongoing preference to deal with gender-based violence matters in customary courts.

"Customary law as it stands in South Sudan does not provide sufficient protection for women, especially in the case of sex-related crimes ... The application of customary law played a significant role in regulating the daily lives of people during the two civil wars leading up to independence. It is therefore not surprising that a large number of South Sudanese feel very passionate about many of the customary laws. However in light of its independence and particularly its formal membership to the international community, the role of human rights is going to play an increasingly important role, requiring some level of reform to existing customary rules, especially those affecting women." Abrahams says the only notable provisions were contained in article 16 of the transitional constitution, which places a "positive obligation on the Government to enact laws to combat harmful customs and traditions which undermine the dignity and status of women." But there are no specifics about what these could be.

"There is a culture of impunity [exemption from punishment] on the African continent as a whole – this marginalises the protective structure that could be in place. "As the newest state joining the international community, South Sudan has major work to do in the area of the promotion and respect for human rights."

HIGH-TECH MATHS, SCIENCE MODEL NURTURES TALENT IN NEGLECTED SCHOOLS

DESPITE 21 years of democracy, there remains an education crisis in the majority of South Africa's schools – particularly when it comes to mathematics and science.

In fact, the 2014 World Economic Forum survey dismally ranked mathematics and science education in South Africa 148th out of 148.

So it is nothing short of remarkable when a learner in a historically-disadvantaged school in a rural Eastern Cape district achieves 96% for maths and 92% for science, as 18-year-old Mava Qolo did in 2014, becoming the top-achieving learner in previously disadvantaged schools in the Cradock district. Or that the Cradock district has been recognised as the third best district nationally, out of 81 districts, in terms of improvement in mathematics over the past four years, and the second best for improvement in physical science.

Neither is it coincidental that four years ago, NMMU's innovative technology-linked but offline teaching and learning model for maths and science – developed by the university's Govan Mbeki Mathematics Development Unit (GMMDU) – was first introduced in this district.

"Education in rural South Africa is a major challenge ... In addition to the legacy left by apartheid, attempts by the post-1994 government to put things right (e.g. outcomes-based education and closing teacher training colleges) have not worked," said GMMDU head Prof Werner Olivier, who holds a FirstRand Foundation Chair in Mathematics Education at NMMU, and who won NMMU's Engagement Award for 2014.

"There are huge deficits in school management and too few teachers of mathematics and science that meet the minimum standards."

What is more, he said, most teachers made no attempts to tune into the changing needs of today's techno-savvy learners, who need to become "productive digital citizens in a socially-connected 21st century world". The consequences are a high drop-out rate, and not nearly enough learners qualifying for science, engineering, technology and related courses at a tertiary level.

For more than eight years, GMMDU, and for the past five years, the FRF Chair, have been working on a teaching and learning model that empowers teachers as professional 21st century practitioners and gives learners in the majority of neglected Eastern Cape secondary schools a chance at boosting their marks. GMMDU – which won a national Impumelelo Social Innovations Gold Award in December 2013 – has always focused on urgent short-term solutions to help learners with potential – those "caught in a vicious education spiral but who aspire to acquire a post-school qualification".

The model has evolved to the point where the entire curricula for Grade 10, 11 and 12 maths and science – in the form of video-based lessons, animated PowerPoint presentations, calculator and exam revision videos, experiments, simulations and the other visual high-tech digital resources – are available on a tablet for learners, as a user-friendly offline package. Through each stage of its development, the FRF Chair has tested the model in 10 Port Elizabeth schools. The central digital support package for the techno-blended model, called TouchTutorTM, also has interactive self-assessment and feedback, along with a Mxit-based maths and science curriculum support system. The support

package is constantly being upgraded as a result of participative action research processes.

An integrated digital look-up (meanings of words) and translation functionality (in any one of six African languages) is currently being embedded as part of the TouchTutorTM package. Learners with potential (picked by GMMDU, in collaboration with the Department of Basic Education) are introduced to the Android tablets through an Incubator School Programme (ISP) or an after-school Tablet Assisted Peer Support (TAPS) programme. In general, learners who attend the ISP or TAPS, and who receive the tablets, improve their marks by at least 10%.

For Qolo, the addition of the ISP and tablet saw his marks going from 5s (60% to 69%) in Grade 10, to 7s (80% to 100%) in Grade 12. He is studying mechatronics at NMMU.

GMMDU has also developed a university accredited professional skills development programme for in-service maths and science teachers, which utilizes the offline teaching and learning model and which has become a second central focus of the unit. TouchTutorTM is available on laptops for teachers as a professional toolkit and for use as a classroom teaching resource. There is also a desktop TouchTutorTM model for after school learner support.

Since 2010, GMMDU's interventions have reached more than 2000 selected learners and over 700 in-service teachers. In recent years, the Department of Education and provincial branches of more than one Sectorial Education and Training Agency (SETA) have chosen to work closely with GMMDU and the FirstRand Chair at NMMU to ensure that an accredited and more sustainable professional development programme for in-service Mathematics teachers is implemented in the Eastern Cape.

As a result, GMMDU's reach has extended to 12 of the 23 districts of the Eastern Cape and also to the Free State.



IMPROVING EDUCATION ... Prof Werner Olivier

PUBLIC ARTWORKS CONTRIBUTE TO A RE-VISUALISED 'INNER CITY'

LONG before the most recent public controversy around sculptures celebrating colonial achievements, NMMU visual arts students were engaged in conversation about the role of public art in the post-colony, and were involved in creating public artworks intended to challenge the status quo and help transform the tarnished face of Port Elizabeth's inner city.

A sustained and ongoing public art project – part of the School of Music, Art and Design's (SoMAD's) larger Visual Arts Strategic Engagement Project – arose out of a Memorandum of Understanding between NMMU and the Mandela Bay Development Agency (MBDA), which has been tasked with rejuvenating and regenerating the inner city, which encompasses the historical suburb of Central and the old CBD that was once the economic and cultural heartland of Port Elizabeth.

The first set of public artworks commissioned by the MBDA formed part of Nelson Mandela Bay's Route 67 – which celebrates the years of service given to South Africa by the Bay's famous namesake, and takes visitors on an art, culture and heritage journey from the Campanile, via the Donkin Reserve, with its exquisitely-patterned mosaic road, to the Athenaeum, with links to South End. "The MBDA is trying to improve the quality of the lived experience in the inner city, and has embraced the internationally-accept-

ed and highly theorised notion that an infusion of public art can assist in transforming the expectations of the citizenry about a place," said SoMAD Director Mary Duker.

"The multi-million rand project has led to significant visual change in the city centre." It has turned places that people had long stopped visiting into tourist attractions and, more importantly, it has helped to make the public spaces more accessible, safer and more attractive, to the people who live and work in the area.

"Over time our students have become increasingly conscious of the social power of art, and this project has provided an opportunity for them to use art as a means of contributing to social cohesion and societal transformation. It has also enabled them to gain experience working on real-time projects that would usually be reserved for well-established artists in their mid-careers," said Duker, who hopes the project and others that continue to flow from it will help to keep the city's creative graduates from leaving for bigger cities.

As part of the Route 67 project, a wide range of works were created. A collective of students under the guidance of David Jones, head of NMMU's Department of Studio Arts, crafted a group of life-sized sculptures, including Nelson Mande-

la, Steve Biko, Govan Mkeki and Vuyisile Mini, as part of an installation entitled "Conversations with the Queen". This work, which is due to be installed outside Port Elizabeth's Main Library, is conceptualised as a conversation between the existing Queen Victoria statue and the stalwarts of the struggle.

In a similar vein, as a conceptual counter-balance and challenge to Port Elizabeth's Campanile, the prominent brick tower commemorating the 1820 settlers, a ceramics student has sculpted a low-relief frieze on a specially constructed curved berm (wall) adjacent to the tower. This work celebrates the contribution of home-born creative practitioners to the cultural richness of the metro. It depicts artists like George Pemba, John Kani, Enoch Sontonga, Danny Williams, Helen Martins, Dennis Brutus and Athol Fugard.

Further projects undertaken, as part of the MBDA Belmont Terrace / Bird Street urban upgrade, include commissioned sculptural works and fabric designs for the repurposed Athenaeum Building in Central. Among these are urban art/graffiti murals celebrating "the power of play", "the power of memory" and "the power of knowledge", the latter including representations of Mandela, Biko, Mother Theresa, Martin Luther King and the Dalai Lama, among others. In Central's Trinder Square, collectives of students and alumni have completed commissions for brightly-coloured mosaic benches.

As the larger project continues to grow, Jones, who is completing his doctoral studies on public sculpture, has met with the MDBA to look at the feasibility of expanding to create a working collective of students and alumni to drive an ongoing maintenance project, focused on the upkeep and restoration of all the public art works in the city.

SoMAD's commitment to the inner city revival was a catalyst for its expansion onto NMMU's Bird Street Campus, where its incubator, pre-tertiary music training and postgraduate visual arts programmes are located, and where the NMMU Institutional Art Gallery (IAG) was launched in mid-2015.

"We celebrate the fact that at NMMU, the understanding of formal research has been expanded to include engagement-focused, practice-based and practice-led research in the creative disciplines research areas that, while they are acknowledged as relevant and important in Europe, the United Kingdom and Australia, have only recently gained academic traction in South Africa," said Duker.



MEETING THE QUEEN ... NMMU art students put the final touches to their life-sized sculptures of struggle icons, who will soon be placed around the existing Queen Victoria statue outside Port Elizabeth's main library, as part of an installation called "Conversations with the Queen".
Picture: Eugene Coetzee



RAINBOW ROAD ... A colourful mosaic pathway – the work of Nelson Mandela Metropolitan University staff and students together with artists from the community – leads tourists and locals alike through the Donkin Reserve.



A NEW LOOK ... Huge murals – depicting the many different identities in South Africa – have given Strand Street a facelift.
Picture: Fritz Schultz

HERO FOREVER ... A young girl hugs a life-sized statue of Nelson Mandela, which forms part of a collection crafted by NMMU art students, as part of a public art project to help change the face of Port Elizabeth's inner city. The Mandela sculpture, along with those of other struggle stalwarts including Steve Biko, Govan Mkeki and Vuyisile Mini, form part of an installation called "Conversations with the Queen", which is due to be installed outside Port Elizabeth's Main Library in Vuyisile Mini Square (formerly Market Square), alongside the existing Queen Victoria statue.

MUSIC IN THE BAY

In addition to the public art initiative, NMMU is instilling a love for music among Bay communities.

Besides the pre-tertiary training (provided to school-going learners wanting to learn instrumental music), NMMU's music department has, for a number of years, been working with the Eastern Cape Philharmonic Orchestra (ECPO) on the latter's "Music Investment Project" to teach music to children in township and Northern Areas schools.

This project has led to the development of the Eastern Cape Philharmonic Youth Orchestra (ECPYO), in which many of the learners play. Seven learners are also part of the ECPO and one is part of the KwaZulu-Natal Philharmonic Orchestra.

For this project, 10 full-time and 10 part-time teachers teach over 500 learners (on recorders and orchestral instruments) and about 250 in choirs.

Unfortunately, after more than a decade's support, National Lottery funding unexpectedly dried up. However NMMU and ECPO are fighting to keep this project alive by raising alternative support. "It's very important to keep it going," said Prof Erik Albertyn, head of NMMU's music department.

NMMU also has an MoU with ECPO, enabling staff and students to perform in the orchestra. "We use this as a development arm for our students."

The department provides regular public musical entertainment events, run through NMMU's collaboration with MBDA.



POWER OF ART ... Port Elizabeth's Athenaeum Building sports urban art/graffiti murals celebrating "the power of play", "the power of memory" and "the power of knowledge", the latter including representations of Nelson Mandela, Steve Biko, Mother Theresa, Martin Luther King, John Lennon, Albert Einstein and the Dalai Lama, among others.

FACULTY HIGHLIGHTS FOR 2014

NMMU'S ADMINISTRATION, MANAGEMENT AND INTERNATIONAL OFFICE

- Institutional Planning Office's senior director Prof Heather Nel won the Award for the Government Category of the Businesswomens' Association of South Africa's (BWA's) Regional Business Achiever Awards.
- Former DVC: Research and Engagement Prof Thoko Mayekiso was appointed by the Department of Higher Education and Training (DHET) to serve on the Research Outputs Evaluation Panel, which evaluates research outputs from all public higher education Institutions submitted to the DHET for subsidy purposes.
- DVC: Teaching and Learning Dr Sibongile Muthwa and Prof Gilinwe Mayende, from the Centre for the Advancement of Non Racialism and Democracy (CANRAD), were appointed by President Jacob Zuma to serve on the Financial and Fiscal Commission (FFC).
- International Education's Dr Nico Jooste was selected by the Association of International Education Administrators (AIEA) as one of 33 "International Education Provocateurs", placing him on a list of recognised world leaders in the field of Higher Education Internationalisation.
- NMMU hosted the International Education Association of South Africa's (IEASA's) 18th Annual Conference in August 2014, themed "The internationalisation of higher education in a world of geo-political reorganisation".



WOMEN-IN-BUSINESS ACHIEVER ... Prof Heather Nel



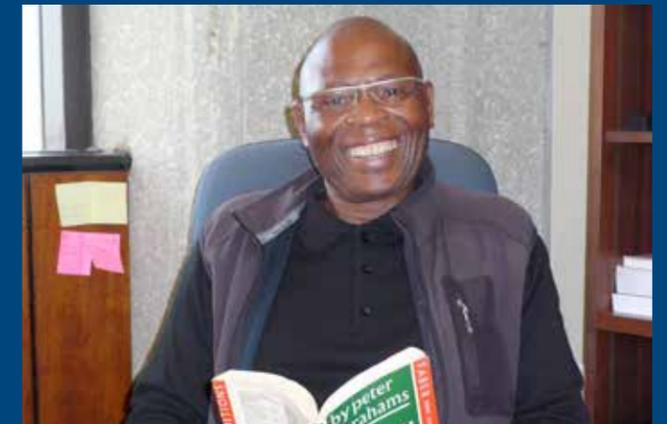
GOVERNMENT APPOINTMENT ... Dr Sibongile Muthwa

FACULTY OF ARTS

- Four international architectural experts presented architectural and technical design workshops to NMMU students and the public at the University's School of Architecture in early 2014. They included the University of Venice's Renato Rizzi, a recipient of an Italian Architecture Gold Medal; Raul Pantaleo, founder of Italy's acclaimed Studio Tamassociati; Stephen Read from Delft University of Technology in the Netherlands; and Prof Ora Joubert, the former head of Architecture of the Free State and Pretoria.
- Language and Literature's Prof Helize van Vuuren, Distinguished Professor in the Faculty of Arts, was one of six national prize winners for an article focusing on aspects of South African writer and poet Breyten Breytenbach's work, which was published on Litnet Academic. Altogether, 17 articles were judged by the South African Academy for Science and Art (SAASA), on behalf of the Afrikaans Language and Culture Society, which awarded the prizes.
- Prof Ncedile Saule presented an inaugural lecture in August 2014, entitled "Sek Mqhayi in the 21st Century: Mzantsi Youth Ideologies within the African Renaissance Paradigm for Sustainable Economic and Political Development".
- Prof Bert Olivier, also a Distinguished Professor, was invited to present a paper at an upcoming conference in Daejeon, South Korea – themed "Science Fiction: East and West".
- NMMU hosted the 21st South African Sociological Association (SASA) Annual Congress in July 2014, themed "The point of critique: Knowledge, society and the state in South Africa after 20 years of democracy".



PRIZE FOR BREYTENBACH ARTICLE ... Prof Helize van Vuuren



Prof Ncedile Saule



ITALIAN INFLUENCE ... Architecture's Ernst Struwig (left) and Dr Magda Minguzzi (right) welcome international architects Paul Pantaleo (second from left) and Renato Rizzi.

FACULTY OF BUSINESS AND ECONOMIC SCIENCES

- NMMU's Family Business Unit and KPMG hosted the country's first Family Business Conference, which addressed topics such as: leadership transition (succession), management and governance in a family business, and how family businesses can expand into Africa.
- In January 2014, NMMU's Family Business Unit director Prof Elmarie Venter was a judge at the Annual Family Enterprise Case Competition (FECC) in Burlington, Vermont (United States), in which students, teams of academics and business owners from more than 25 countries participated. She also attended the Price-Babson Symposium for Entrepreneurship Educators at Babson University.
- Leading entrepreneurship scholar Prof Saras Sarasvathy – a world-class speaker and researcher from Darden School of Business, University of Virginia in the United States – presented a talk at NMMU on "entrepreneurial success in a volatile environment".
- United States marketing guru Prof Naresh Malhotra, author of a number of leading marketing textbooks, gave a talk on the forces driving

FAMILY TIES ... Attending the country's first Family Business Conference, organised by NMMU's Family Business Unit and KPMG, were (from left) KPMG's Alan Barr, Coca-Cola Sabco's Phil Gutsche, KPMG's Christophe Bernard, NMMU's Prof Elmarie Venter and Tavor Motor Company's Alan Taverner.

globalisation, and the research that needs to be done to penetrate foreign markets. Malhotra is a Senior Fellow at Georgia Tech Centre for International Business Education and Research (CIBER), and Regent's Professor Emeritus at the Scheller College of Business at Georgia Institute of Technology.

- Staff in this faculty presented a number of inaugural lectures: Business Management's Prof Elroy Smith spoke on "Beyond greening: Reflections on the business sustainability imperative"; Economics' Prof Matthew Ocran's inaugural lecture was entitled "Resource nationalism: A threat or a panacea to economic development?"; while Business Management's Prof Sandra Perks presented an inaugural lecture entitled "Local economic development: Disseminating global best practices to affect futuristic thinking in SA".



FACULTY OF EDUCATION

- HIV & Aids Education Research Chair Prof Naydene de Lange was runner-up in the Department of Science and Technology's South African Women in Science Awards (Social Sciences and Humanities).
- NMMU'S Education Department hosted the Southern African Association for Research in Mathematics, Science and Technology Education (SAARMSTE) conference, which was attended by 200 delegates from around the world. It was themed "New avenues to transform Mathematics, Science and Technology Education in Africa".
- Together with partners in Germany, Tanzania and Uganda, NMMU won the bid for a Centre of Excellence for Educational Research Methods and Management in East and South Africa (CERM-ESA). The project is funded by the German Academic Exchange Service (DAAD), with the support of the German Federal Foreign Office.



WOMEN IN SCIENCE AWARD ... Prof Naydene de Lange

- To reflect the visual nature of her research, innovative Education PhD student Avivit Cherrington took a creative approach to presenting her research at an international conference in Prague, Czech Republic. Breaking away from traditional verbal proceedings, Cherrington handed out play-dough, colourful buttons and sticks to members of the audience at the 6th Global Conference of Hope: Probing the Boundaries. Her study, exploring hope from the perspective of children attending a rural after-care centre in the Free State, garnered a lot of interest at the conference.

- A Colloquium on Humanising Pedagogies was hosted by the Faculty of Education in November 2014, to build on the theoretical approaches to the concept of Humanising Pedagogies and the various praxes and practices associated with this concept.



NOVEL PRESENTATION APPROACH ... Avivit Cherrington

FACULTY OF ENGINEERING, THE BUILT ENVIRONMENT AND INFORMATION TECHNOLOGY (EBEIT)

- Twenty-five Nelson Mandela Bay primary school teachers were equipped to share cyber safety tips with their learners through a workshop presented by NMMU's Group for Research in Information and Cyber Security. The workshop provided free cyber safety curriculum, which included 24 lesson plans, associated discussion questions, assessment work sheets and memoranda. As no formal curriculum in this regard exists in most South African schools, this cyber safety curriculum is an effort to fill this gap.
- Prof Rossouw von Solms, Distinguished Professor and Director of the Institute for ICT Advancement, has been appointed by the Institute for Information Technology Professionals South Africa (IITPSA) as South Africa's national representative to the General Assembly of the International Federation for Information Processing (IFIP). The IFIP is an international body in the field of IT and has 56 countries as members, bringing together more than a million experts in the field of IT. School of ICT's Prof Johan van Niekerk was appointed by (IITPSA) as the new South African representative to the Technical Committee 3 (TC3) of IFIP.

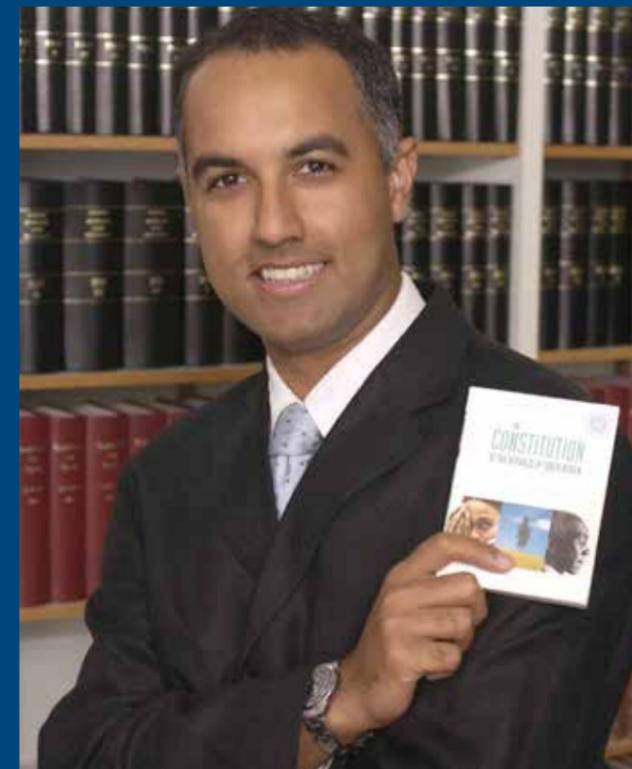


- In May 2015, for a period of five years, Prof Darelle van Greunen was elected as chair of the board of Living Labs in Southern Africa (LLISA), an affiliate of the African Union and the European Commission.
- ICT research associate Dr Laurie Butgereit delivered a keynote address on mobile education support at the 14th International Arab Conference on Information Technology, held in Khartoum, Sudan. Her talk focused on IT supporting mobile education in an environment with constraints such as low bandwidth and unstable electricity supplies.
- School of ICT's Prof Dalencia Pottas presented an inaugural lecture in October 2014, entitled "Consumer health informatics in the information age and beyond".
- NMMU hosted the International Development Informatics Association Conference in November 2014, themed "ICT for inclusive communities in developing societies".
- Also in November, the university hosted the African Cyber Citizenship Conference, themed "Cyberspace and its impact on society".

CYBER AWARENESS ... School of ICT professors (from left) Johan van Niekerk, Kerry-Lyn Thomson and Rossouw von Solms, take a look at cyber safety posters designed by primary school teachers.

FACULTY OF HEALTH SCIENCES

- Prof Mark Watson, Distinguished Professor of the Department of Psychology, has been appointed to the Executive Evaluation Committee (EEC) of the NRF. This is their highest decision-making body for potential NRF ratings.
- The Faculty of Health Sciences hosted the Sports Nutrition Symposium of the Association for Dietetics in South Africa in April 2014.
- The Sustainable Futures: Green Medicine Symposium was hosted at the George Campus in March 2014.
- 2014 saw the introduction of NMMU's new Bachelor of Emergency Medical Care (BEMC) programme, one of the first building blocks towards a fully-fledged medical school at NMMU.
- Health Minister Dr Aaron Motsoaledi was keynote speaker at the annual launch of "First things first", a national campaign for HIV testing and counselling within higher education, which was hosted by NMMU.



ACADEMY OF SCIENCE ACHIEVER ... Prof Avinash Govindjee

FACULTY OF LAW

- Public Law Head Prof Avinash Govindjee was inducted as a member of the South African Young Academy of Science (SAYAS) for five years. The induction took place at the annual awards ceremony of the Academy of Science of South Africa (ASSAF) in Pretoria.
- Prof Patrick Vrancken was appointed as one of the 18 members (and the only member from a developing country) of the International Law Association Committee on International Law and Sealevel Rise.
- In November 2014, NMMU hosted the 2014 African Maritime Domain conference (led by Prof Vrancken).
- Institute for Law in Action director Prof Hennie van As was invited to be part of a four-member team of experts to assist the government of Timor to draft new legislation in order to establish a system of local government. The event was facilitated by the World Bank.



AID FOR TIMOR ... Institute for Law in Action director Prof Hennie van As (right), joined by India's Prof Krippa Anantphur (left) and Nepal's Dr Saroj Nepal, attend a talk by the Timorese government.

FACULTY OF SCIENCE

- Prof Mike Lee of NMMU's Centre for High Resolution Transmission Electron Microscopy (HRTEM) presented a keynote address on atomic scale crystallography at the South African conference and world summit of the International Year of Crystallography, which was attended by more than 100 participants from 20 countries in Africa and Europe.

- An international workshop spearheaded by the HRTEM Centre in March, was the catalyst for the creation of a new international knowledge network, which will include some of the world's top electron microscopy and materials experts. Their focus is to accelerate the development of advanced materials in South Africa, thereby contributing towards the beneficiation of the country's mineral resources.

- Two of the world's foremost experts on solar energy – Germany's Prof Eicke Weber, founding president of the German Energy Storage Association and winner of the Solar World Einstein Award, and Dr Michael Geyer, director for international business development of Abengoa Solar SA – shared their ideas and research at the second Southern African Solar Energy Conference (Sasec 2014), hosted by NMMU.

- Southern right and humpback whale research in Algoa Bay received an R800 000 boost following a memorandum of understanding between



CRYSTALLOGRAPHY EXPERT ... The HRTEM Centre's Prof Mike Lee was a keynote speaker at a crystallography conference, which attracted participants from across the globe.



SOLAR EXPERTS ... Speakers at the second Southern African Solar Energy Conference (Sasec 2014) included (from left) NMMU's Centre for Energy Research director Prof Ernest van Dyk, Germany's Prof Eicke Weber, founding president of the German Energy Storage Association, Abengoa Solar SA's Dr Michael Geyer, the Department of Science and Technology's Mmboneni Muofhe and Stellenbosch University's Prof Wikus Van Niekerk.

NMMU and Transnet National Port Authority. Cutting-edge research on these two baleen whale species, coupled with concerns about the impact that continued shipping and construction noise may have on these mammals (in light of the Ngqura harbour at Coega), will benefit from the agreement.

- The possibility of NMMU becoming a future African leader in maritime and marine sciences took a step in the right direction with the signing of a formal agreement with the World Maritime University in Sweden, an institution that has been recognised by the United Nations for promoting international maritime education. The link with WMU gives NMMU access to a wide network of global maritime players in developed and developing countries.

- Prof Renzo Perissinotto presented an inaugural lecture in October 2014, entitled "South African Estuaries in the Anthropocene".

- In December, under the auspices of the Africa Earth Observatory Network – Earth Stewardship Research Institute (AEON-ESSRI), NMMU hosted the National Global Change Conference.



DECADES OF MICROSCOPY EXPERIENCE ... Ohio State University's Prof Hamish Fraser (left) and NMMU's Prof Jannie Neethling (right) shared the podium at an international advanced electron microscopy conference with their respective doctoral promoters Prof Mike Loretto (second from left) from the University of Birmingham and Prof Hennie Snyman, retired rector and Vice-Chancellor of the former Port Elizabeth Technikon.



FUTURE MARITIME LEADER ... World Maritime University Acting President Neil Bellefontaine (left) and NMMU Vice-Chancellor Prof Derrick Swartz shake hands after signing a Memorandum of Cooperation.

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